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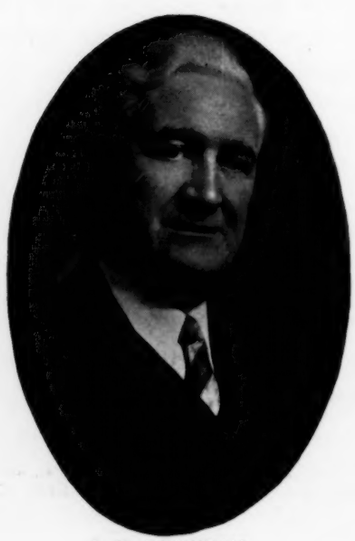

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J. C. Reed, Elec. Supt., Bethlehem Steel Co., Steelton, Pa.
W. W. Garrett, Engr. of Tests, Elec. Lab., Tennessee Coal, Iron & R. R. Co., Fairfield, Ala.
E. L. Upp, Elec. Supt., National Tube Co., McKeesport, Pa.
J. S. O'Donovan, Elec. Supt., Spang Chalfant and Co., Inc., Etna, Pa.
Charles Schenk, Supt. of Prod., Bethlehem Steel Co., Bethlehem, Pa.
C. M. Myers, Asst. Elec. Engr., Youngstown Sheet & Tube Co., Youngstown, Ohio.
F. W. Cramer, Chief Elec. Engr., Republic Steel Corp., Youngstown, Ohio.
A. F. Davis, Vice Pres., Lincoln Electric Co., Cleveland, Ohio.
A. M. Candy, Engr., Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
H. A. Winne, Industrial Eng. Dept., General Electric Co., Schenectady, N. Y.
A. B. Churchill, Elec. Supt., American Bridge Co., Ambridge, Pa.
E. H. Cocain, Chief Elec., Pittsburgh Steel Co., Monessen, Pa.

ELECTRIC HEAT COMMITTEE

Chairman, N. C. Bye, Chief Engr., Henry L. Disston & Sons, Inc., Tacony, Philadelphia, Pa.
Wirt Scott, Engr., Westinghouse Elec. & Mfg. Co., Mansfield, Ohio.
R. H. Bryant, Elec. Engr., American Steel & Wire Co., Worcester, Mass.
R. W. Heller, Power Engr., Duquesne Light Co., Pittsburgh, Pa.
J. W. Bates, Elec. Engr., American Sheet & Tin Plate Co., Pittsburgh, Pa.
W. W. Wallis, Pres., Pittsburgh Electric Furnace Co., Pittsburgh Pa.
F. McQuillan, Industrial Sales Mgr., West Penn Power Co., Pittsburgh, Pa.
J. B. Jackson, Engr., Ohio Edison Co., Youngstown, Ohio.
George H. Schaeffer, Elec. Engr., Carpenter Steel Co., Reading, Pa.
R. J. Hartley, Engr., Simonds Saw & Steel Co., Lockport, N. Y.
E. N. Calhoun, Sales Mgr., Edwin L. Wiegand Co., Pittsburgh, Pa.
C. F. Cone, Engr., Geo. J. Hagan Co., Pittsburgh, Pa.
D. M. Petty, Supt. of Service Dept., Bethlehem Steel Co., Bethlehem, Pa.
F. C. Watson, Elec. Engr., International Nickel Co., Huntington, W. Va.
Robert L. McIntosh, Indiana Harbor, Ind.
R. F. Benzinger, Vice Pres., Electric Furnace Co., Salem, Ohio.
E. F. Northrup, Vice Pres., Ajax Electrothermic Corp, Trenton, N. J.
S. Arnold, III, Sales Engr., Heroult Electric Furnaces, Pittsburgh, Pa.
W. C. Jahn, Engr., American Sheet & Tin Plate Co., Gary, Ind.
A. W. Duncan, Elec. Supt., Weirton Steel Co., Weirton, W. Va.
C. H. Fielding, Wks. Supt., Rustless Iron Corp., Baltimore, Md.
O. M. Svennson, Engr., Vanadium Corp. of America, Bridgeville, Pa.

ELECTRICAL DEVELOPMENTS COMMITTEE

Chairman, W. H. Burr, Mech. and Elec. Supt., Lukens Steel Co., Coatesville, Pa.

Main Roll Division

G. E. Stoltz, Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
J. D. Wright, General Electric Co., Schenectady, N. Y.
R. W. Davis, Allis Chalmers Mfg. Co., Milwaukee, Wis.
W. H. Feldman, Electric Machinery Mfg. Co., Minneapolis, Minn.
B. D. Christian, Crocker-Wheeler Elec. Mfg. Co., Ampere, N. J.
C. C. Hutchins, Elliott Co., Ridgway, Pa.

Auxiliary Drives and General Purpose Motors Division

R. H. Wright, Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
A. M. MacCutcheon, Reliance Elec. & Engr. Co., Cleveland, Ohio.
J. R. Lewis, Crocker-Wheeler Elec. Mfg. Co., Pittsburgh, Pa.
C. C. Hutchins, Elliott Co., Ridgway, Pa.
J. C. Barry, General Electric Co., Erie, Pa.
W. H. Powell, Allis Chalmers Mfg. Co., Milwaukee, Wis.
J. S. Lincoln, Lincoln Electric Co., Cleveland, Ohio.
L. H. Tippins, U. S. Electrical Mfg. Co., Pittsburgh, Pa.
J. M. Moore, Sterling Electric Motors, Inc., Pittsburgh, Pa.
G. H. Barnard, Acting Mgr. of Sales, Electro Dynamic Co., Bayonne, N. J.

Control Division

T. S. Towle, Cutler-Hammer, Inc., Pittsburgh, Pa.
W. H. Williams, Clark Controller Co., Cleveland, Ohio.
R. G. Widdows, Electric Controller & Mfg. Co., Cleveland, Ohio.
H. A. Winne, General Electric Co., Schenectady, N. Y.
D. W. Dean, Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
Joseph F. Frese, Monitor Controller Co., Baltimore, Md.
J. S. Rowan, Rowan Controller Co., Baltimore, Md.

Crane Division

G. W. Yanney, Alliance Machine Co., Alliance, Ohio.
F. H. Barnard, Morgan Engineering Co., Alliance, Ohio.
W. C. Heinle, Cleveland Crane & Engineering Co., Wickliffe, Ohio.
H. S. Griffith, Manning, Maxwell & Moore, Inc., Pittsburgh, Pa.
Sydney Buckley, Shepard Niles Crane & Hoist Corp., Philadelphia, Pa.
Norman Farrar, Harnischfeger Corp., Philadelphia, Pa.
A. J. Brown, Whiting Corp., Chicago, Ill.

Transmission Equipment Division

F. E. Fairman, General Electric Co., Pittsburgh, Pa.

N. C. Goin, Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.
R. E. Uptegraff, R. E. Uptegraff Mfg. Co., Pittsburgh, Pa.
A. H. Dyckerhoff, Commonwealth Edison Co., Chicago, Ill.
Samuel Horelick, Pennsylvania Transformer Co., Pittsburgh, Pa.
G. L. Crosby, Roller Smith Co., New York, N. Y.
W. M. Scott, I-T-E Circuit Breaker Co., Philadelphia, Pa.
William Wray, Allis Chalmers Mfg. Co., Pittsburgh, Pa.
A. F. Alsaker, Delta Star Electric Co., Chicago, Ill.
W. M. McCauley, Railway & Industrial Engr. Co., Greensburg, Pa.
L. R. Lewis, Electric Power Equipment Corp., Philadelphia, Pa.
J. J. Mullen, Moloney Electric Co., St. Louis, Mo.
J. S. Livingston, Schweitzer & Conrad, Inc. Chicago, Ill.
L. B. Gawthrop, Electric Service Supplies Co., Philadelphia, Pa.
B. M. Jones, Duquesne Light Co., Pittsburgh, Pa.
R. L. Baker, Metropolitan Edison Co., Reading, Pa.
M. E. Noyes, Aluminum Company of America, Pittsburgh, Pa.
H. E. Ransford, G. & W. Electric Specialties Co., Pittsburgh, Pa.
P. Maher, General Cable Corp., New York, N. Y.
J. J. O'Brien, Okonite Company, Chicago, Ill.
J. S. Rashba, Rockbestos Products Corp., Pittsburgh, Pa.
A. N. Cartwright, West Penn Power Co., Pittsburgh, Pa.

Generating Equipment Division

R. H. Wright, Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
Paul Caldwell, General Electric Co., Pittsburgh, Pa.
W. H. Powell, Allis Chalmers Mfg. Co., Milwaukee, Wis.
L. O. Gregg, Elliott Company, Pittsburgh, Pa.
J. R. Lewis, Crocker-Wheeler Elec. Mfg. Co., Pittsburgh, Pa.

Miscellaneous Division

H. Lee Reynolds, H. Lee Reynolds Co., Pittsburgh, Pa.
J. J. Bangert, Crouse-Hinds Co., Pittsburgh, Pa.
M. S. Robinson, Erie Malleable Iron Co., Pittsburgh, Pa.
A. E. Tregenza, Jefferson Electric Co., Bellwood, Ill.
T. P. McGinnis, Pyle National Co., Pittsburgh, Pa.
B. M. Slicting, Trico Fuse Mfg. Co., Milwaukee, Wis.
W. C. Anderson, Trumbull Elec. Mfg. Co., Pittsburgh, Pa.
W. L. DeCoursey, Economy Fuse & Mfg. Co., Pittsburgh, Pa.
G. L. Stout, Colt's Patent Fire Arms Mfg. Co., Pittsburgh, Pa.
H. E. Burns, H. E. Burns Co., Pittsburgh, Pa.
E. B. Beach, E. B. Beach Company, Pittsburgh, Pa.
E. S. Stickle, E. S. Stickle Co., Pittsburgh, Pa.
H. E. Slack, Bussmann Mfg. Co., Pittsburgh, Pa.
T. M. Rees, Bryant Mach. & Engr. Co., Pittsburgh, Pa.

Instruments

R. M. Walker, Bristol Company, Chicago, Ill.
A. R. Richardson, General Electric Co., Philadelphia, Pa.
G. L. Crosby, Roller Smith Co., New York, N. Y.
R. W. Leech, Westinghouse Elec. & Mfg. Co., Pittsburgh, Pa.
L. D. Joralemon, Weston Electrical Instrument Corp., Philadelphia, Pa.
L. O. Morrow, Esterline-Angus Co., Philadelphia, Pa.
G. D. Conlee, Republic Flow Meters Co., Chicago, Ill.
C. L. Clapper, Brown Instrument Co., Pittsburgh, Pa.
I. M. Stein, Leeds & Northrup Co., Philadelphia, Pa.

PORTABLE ELECTRICAL TOOL COMMITTEE

Chairman, P. W. Miller, Asst. Elec. Supt., Carnegie Steel Co., Clairton, Pa.
W. C. Buske, M. M., McConway & Torley Co., Pittsburgh, Pa.
A. F. Jones, Chief Elec., Champion Machine & Forging Co., Cleveland, Ohio.
F. M. Sturgess, Chief Elec., American Steel & Wire Co., Fairfield, Ala.
H. L. Coe, Elec. Engr., Carnegie Steel Co., Mingo Junction, Ohio.
W. C. McClelland, Elec. Supt., Standard Tin Plate Co., Canonsburg, Pa.
George H. McFeaters, Elec. Engr., Lorain Steel Co., Johnstown, Pa.
G. J. Walz, Asst. Elec. Engr., Bethlehem Steel Co., Steelton, Pa.
S. E. McQuigg, Chief Elec., Allegheny Steel Co., Brackenridge, Pa.
P. J. McGrane, Chicago Heights, Ill.
James Maloney, Chief Elec., Superior Steel Corp., Carnegie, Pa.
Henry Molz, Chief Elec., Allegheny River Mining Co., Kittanning, Pa.
J. R. Penman, Elec. Supt., Reading Iron Co., Reading, Pa.
J. S. O'Donovan, Elec. Supt., Spang Chalfant and Co., Inc., Etna, Pa.
W. J. Davis, Chief Elec., Scullin Steel Co., St. Louis, Mo.
H. F. Raab, Asst. Elec. Supt., Bethlehem Steel Co., Johnstown, Pa.
D. W. McFayden, Chief Elec., Universal Portland Cement Co., Universal, Pa.
William Anderson, Chief Elec., Sellers Mfg. Co., Chicago, Ill.
James Riles, Pittsburgh, Pa.
J. R. Lytle, Chief Elec., Vulcan Mould & Iron Co., Latrobe, Pa.
James H. Reiners, Mgr., Pittsburgh Screw & Bolt Co., N. S., Pittsburgh, Pa.
George Pfeffer, Elec. Supt., Florence Pipe Foundry & Machine Co., Florence, N. J.
J. C. Ritchey, Elec. Engr., Pressed Steel Car Co., McKees Rocks, Pa.
R. F. Waldo, Dist. Mgr., Ideal Commutator Dresser Co., Pittsburgh, Pa.
H. McFarland, Sales Mgr., Martindale Electric Co., Cleveland, Ohio.
A. L. Krumhaus, Chief Elec., Globe Steel Tube Co., Milwaukee, Wis.

COMMUTATION COMMITTEE

Chairman, O. H. Meineke, Elec. Supt., Spang Chalfant Co., Inc., Ambridge, Pa.
J. Walter Becker, Ideal Commutator Dresser Co., Sycamore, Ill.
A. S. Bemis, Speer Carbon Company, St. Marys, Pa.
A. M. Ramsey, LeCarbone Company, Pittsburgh, Pa.
E. G. Gerber, Diamond Carbon Co., Pittsburgh, Pa.
R. F. Hausen, Pittsburgh Carbon Brush Co., Pittsburgh, Pa.
A. B. Holcombe, D. B. Flower Mfg. Co., Pittsburgh, Pa.
R. B. Huffmen, Henrite Products Co., Pittsburgh, Pa.
P. D. Manbeck, National Carbon Co., Inc., Cleveland, Ohio.
J. S. Marcus, Electro-Nite Carbon Co., Philadelphia, Pa.
E. H. Martindale, Martindale Electric Co., Cleveland, Ohio.
Wm. Siebenmorgan, Electro Service Inc., Union City, N. J.
Carl L. Sittler, Pure Carbon Co., Chicago, Ill.
Geo. P. Mountford, Ohio Carbon Co., Cleveland, Ohio.
J. H. Albrecht, Calebaugh Carbon Co., Pittsburgh, Pa.
A. T. Kelly, Stackpole Carbon Co., St. Marys, Pa.
F. B. Godard, U. S. Graphite Co., Pittsburgh, Pa.
E. A. Lapham, Morganite Brush Co., Inc., New York, N. Y.

AIR CONDITIONING COMMITTEE

Chairman, T. J. Flaherty, Elec. Supt., American Rolling Mill Co., Ashland, Ky.
R. E. Lewis, Elec. Supt., Youngstown Sheet & Tube Co., Youngstown, Ohio.
J. H. Milliken, American Air Filter Co., Inc., Chicago, Ill.
T. E. Hughes, Supt., Maintenance & Mechanical Departments, Carnegie Steel Co., Duquesne, Pa.
W. H. Beyerly, Asst. Elec. Supt., Bethlehem Steel Co., Sparrows Point, Md.
G. R. Carroll, Elec. Supt., Jones & Laughlin Steel Corp., Aliquippa, Pa.

W. S. Hall, Supt. Engr. and Constr., Illinois Steel Co., South Chicago, Ill.
J. E. Sayer, Asst. Chief Elec., Tennessee Coal, Iron & R. R. Co., Ensley, Ala.
J. D. Donovan, Elec. & Mech. Supt., Republic Steel Corp, Massillon, Ohio.

TRANSPORTATION COMMITTEE

Chairman, J. W. Bates, Elec. Engr., Power Div., American Sheet & Tin Plate Co., Pittsburgh, Pa.
George H. Criss, H. E. McCoy Co., Pittsburgh, Pa.
A. H. Candee, Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.
R. S. Richards, Atlas Car Mfg. Co., Cleveland, Ohio.
L. N. Crissman, Electric Storage Battery Co., Pittsburgh, Pa.
J. K. Mahaffey, Edison Storage Battery Co., Pittsburgh, Pa.
G. M. Barker, Philadelphia Storage Battery Co., Pittsburgh, Pa.
E. Coates, Elec. Supt., Republic Steel Corp., Buffalo, N. Y.
S. L. Henderson, Elec. Supt., American Steel & Wire Co., Central Fces., Cleveland, Ohio.
G. W. Black, Elec. Supt., Carnegie Steel Co., Clairton, Pa.

SHOP PRACTICES COMMITTEE

Chairman, E. C. Marshall, Elec. Supt., Youngstown Sheet & Tube Co., East Chicago, Ind.
O. H. Meineke, Elec. Supt., Spang Chalfant and Co., Inc., Ambridge, Pa.
W. A. Perry, Elec. Supt., Inland Steel Co., Indiana Harbor, Ind.
George Pfeffer, Elec. Supt., Florence Pipe Foundry & Machine Co., Florence, N. J.
C. M. Thompson, Jr., Prod. Engr., Henry L. Disston & Sons, Inc., Tacony, Philadelphia, Pa.
S. G. Rainbow, Asst. Elec. Supt., Jones and Laughlin Steel Corp., Aliquippa, Pa.
L. R. Rankin, Elec. Supt., Carnegie Steel Co., Farrell, Pa.
F. S. Auer, Asst. Elec. Supt., Carnegie Steel Co., New Castle, Pa.
R. F. Gale, Plant Engr., Midvale Company, Nicetown, Philadelphia, Pa.
W. W. Barefoot, Elec. Supt., Carnegie Steel Co., McKees Rocks, Pa.
C. E. Miller, Elec. Dept., Carnegie Steel Co., Clairton, Pa.
J. S. Murray, Chief Elec. Engr., Follansbee Bros. Co., Follansbee, W. Va.
Paul Canney, Elec. Supt., Minnesota Steel Co., Duluth, Minn.
G. N. Hughes, Elec. Supt., Gulf States Steel Co., Alabama City, Ala.
H. S. Harding, Elec. Shop Foreman, Great Lakes Steel Corp., Ecorse, Mich.
G. N. Harmon, Elec. Supt., Republic Steel Corp., Warren, Ohio.
R. E. Carter, Elec. Engr., Empire Steel Corp., Niles, Ohio.

COMBUSTION ENGINEERING DIVISION

EXECUTIVE COMMITTEE

Engineering Section Director, Chairman, F. E. Leahy, Fuel Engr., Youngstown Sheet & Tube Co., Youngstown, Ohio.
Secretary, T. J. Ess, Comb. Engr., Republic Steel Corp., Massillon, Ohio.
W. N. Flanagan, Spec. Engr., Carnegie Steel Co., Pittsburgh, Pa.
H. V. Flagg, Asst. Comb. Engr., American Rolling Mill Co., Middletown, Ohio.
Martin J. Conway, Comb. Engr., Lukens Steel Co., Coatesville, Pa.
H. C. Siebert, Comb. Engr., Bethlehem Steel Co., Bethlehem, Pa.

Gas Utilization Section

Chairman, G. T. Hollett, Comb. Engr., Illinois Steel Co., South Chicago, Ill.
W. N. Flanagan, Spec. Engr., Carnegie Steel Co., Pittsburgh, Pa.
A. G. Witting, Chief Engr., Illinois Steel Co., Gary, Ind.
F. G. Cutler, Chief Bureau of Steam Engr., Tennessee Coal, Iron & R. R. Co., Ensley, Ala.
J. G. West, Jr., Asst. Gen. Mgr., Jones & Laughlin Steel Corp., Pittsburgh, Pa.
A. J. Boynton, Vice President, H. A. Brassert & Co., Chicago, Ill.
W. H. Cosgrove, Pres., Gas Combustion Co., Pittsburgh, Pa.
H. Dobrin, Consulting Fuel Engr., Pittsburgh, Pa.
W. E. Bisler, Engr., Combustion Engr. Corp., New York, N. Y.
J. C. Hayes, Engr., Freyn Engineering Co., Chicago, Ill.
Karl L. Landgrebe, Vice Pres., Tennessee Coal, Iron & R. R. Co., Birmingham, Ala.
J. W. Jones, Steam Engr., Wheeling Steel Corp., Portsmouth, Ohio.
Wilfred Sykes, Asst. to Pres., Inland Steel Co., Chicago, Ill.
W. J. McGurty, Bartlett Hayward Co., Pittsburgh, Pa.
C. W. Hedberg, Research Corp., Bound Brook, N. J.
R. R. Harmon, Chemical Engr., Peabody Engineering Corp., New York, N. Y.
J. L. Hott, Comb. Engr., Wickwire Spencer Steel Co., Buffalo, N. Y.

Gas Producer Section

Chairman, F. E. Leahy, Fuel Engr., Youngstown Sheet & Tube Co., Youngstown, Ohio.
G. R. McDermott, Vice Pres., Chapman Stein Div., Surface Combustion Corp., Toledo, Ohio.
A. L. Foell, Chief Engr., Arthur G. McKee Co., Cleveland, Ohio.
L. C. Edgar, Chief Engr., Edgar Thomson Works, Carnegie Steel Co., Braddock, Pa.
C. W. Phillips, Gen. M. M., Republic Steel Corp., Warren, Ohio.
L. F. Coffin, Gen. M. M., Bethlehem Steel Co., Sparrows Point, Md.
W. J. Harper, Chief Comb. Engr., Republic Steel Corp., Youngstown, Ohio.
H. C. Siebert, Comb. Engr., Bethlehem Steel Co., Bethlehem, Pa.
S. M. Jenks, Fuel Engr., American Sheet & Tin Plate Co., Gary, Ind.
G. A. Merkt, Engineer, Industrial Control Dept., Morgan Construction Co., Worcester, Mass.

Furnace Section

Chairman, G. M. Coughlin, Comb. Engr., American Rolling Mill Co., Ashland, Ky.
F. G. Gasche, Comb. Eng., Buffalo, N. Y.
H. C. Siebert, Comb. Engr., Bethlehem Steel Co., Bethlehem, Pa.
S. Kneass, Engr., Lief Lee Company, Pittsburgh, Pa.
A. W. Steed, Supt. Maint., American Rolling Mill Co., Middletown, Ohio.
Karl H. Marsh, Chief Engr., British Empire Steel Co., Sydney, N. S., Canada.
G. T. Hollett, Comb. Engr., Illinois Steel Co South Chicago, Ill.
L. Ellman, Vice Pres., M. H. Detrick Co., Pittsburgh, Pa.
Joseph Kennedy, Julian Kennedy Co., Pittsburgh, Pa.
W. R. Culbertson, Dist. Mgr., Rust Engineering Co., Pittsburgh, Pa.
G. R. McDermott, Vice Pres., Chapman Stein Div., Surface Combustion Corp., Toledo, Ohio.
E. H. Younglove, Johns Manville, Inc., Chicago, Ill.
A. G. Witting, Chief Engr., Illinois Steel Co., Gary, Ind.
John Lehnert, Comb. Engr., Republic Steel Corp., Massillon, Ohio.
C. H. Hunt, Asst. to Pres., Weirton Steel Co., Weirton, W. Va.
S. Naismith, Refractory Engr., Illinois Steel Co., South Chicago Ill.
W. P. Chandler, Special Eng., Blaw Knox Co., Blawnox, Pa.
A. V. Ritts, Chief Engr., Costello Engr. Co., Pittsburgh, Pa.
W. H. Cosgrove, Pres., Swindell-Dresser Corp., Pittsburgh, Pa.
G. A. Merkt, Industrial Control Dept., Morgan Construction Co., Worcester, Mass.

Steam Generation and Utilization Section

Chairman, J. L. Miller, Steam Engr., Carnegie Steel Co., Youngstown, Ohio.

L. C. Edgar, Chief Engr., Edgar Thomson Works, Carnegie Steel Co., Braddock, Pa.
E. W. Trexler, Steam Engr., Bethlehem Steel Co., Johnstown, Pa.
J. B. Crane, Engr., Combustion Engineering Corp., Pittsburgh, Pa.
James Rath, Power Dept., National Tube Co., McKeesport, Pa.
S. H. McKee, Consulting Engineer, Youngstown, Ohio.
E. Kieft, Engr. of Tests, Illinois Steel Co., Gary, Ind.
C. H. Verwohlt, Works Engr., Wheeling Steel Corp., Wheeling, W. Va.
A. L. Penniman, Jr., Supt. Steam Station, Consolidated Gas, Electric, Light & Power Co., Baltimore, Md.
E. C. McDonald, Asst. Steam Engr., Republic Steel Corp., Buffalo, N. Y.
C. H. Williams, Steam Engr. Dept., Carnegie Steel Co., Ohio Works, Youngstown, Ohio.
E. P. Winters, Power Engr., Sloss Sheffield Steel & Iron Co. North Birmingham, Ala.
L. F. Fairthorne, Battelle Memorial Institute, Columbus, Ohio.

Liquid Fuel Section

Chairman, W. J. Harper, Chief Comb. Engr., Republic Steel Corp., Youngstown, Ohio.
F. G. Gasche, Comb. Engr., Buffalo, N. Y.
H. C. Siebert, Comb. Engr., Bethlehem Steel Co., Bethlehem, Pa.
S. Kneass, Eng., Lief Lee Company, Pittsburgh, Pa.
A. K. McMillen, Chief Engr., Alex Laughlin & Co., Pittsburgh, Pa.
A. W. Steed, Supt. Maint., American Rolling Mill Co., Middletown, Ohio.
Joseph G. Walsh, Asst. Gen. Supt., Republic Steel Corp., Birmingham, Ala.
Karl H. Marsh, Chief Engr., British Empire Steel Co., Sydney, N. S., Canada.
G. T. Hollett, Comb. Engr., Illinois Steel Co., South Chicago, Ill.
L. Ellman, Vice Pres., M. H. Detrick Co., Pittsburgh, Pa.
Joseph Kennedy, Julian Kennedy Co., Pittsburgh, Pa.
W. R. Culbertson, Distr. Mgr., Rust Engineering Co., Pittsburgh, Pa.
G. R. McDermott, Vice Pres., Chapman Stein Div., Surface Combustion Corp., Toledo, Ohio.
A. G. Witting, Chief Engr., Illinois Steel Co., Gary, Ind.
John Lehnert, Comb. Engr., Republic Steel Corp., Massillon, Ohio.
C. H. Hunt, Asst. to Pres., Weirton Steel Co., Weirton, W. Va.
S. Naismith, Refractory Engr., Illinois Steel Co., South Chicago, Ill.
W. P. Chandler, Jr., Spec. Engr., Blaw Knox Co., Blawnox, Pa.

Instrument and Control Section

Chairman, M. J. Conway, Comb. Engr., Lukens Steel Co., Coatesville, Pa.
J. Wallace, M. M., Wheeling Steel Corp., Benwood Works, Wheeling, W. Va.
J. C. Allen, Chief Engr., Carnegie Steel Co., New Castle, Pa.
Geo. M. Coughlin, Combustion Engineer, American Rolling Mill Co., Ashland, Ky.
Carl Fischer, Supt. Light, Heat and Power, Mesta Machine Co., West Homestead, Pa.
R. M. Walker, Dist. Mgr., Bristol Co., Chicago, Ill.
G. D. Conlee, Chief Engr., Republic Flow Meters Co., Chicago, Ill.
J. M. Hopwood, Pres., Hagan Corporation, Pittsburgh, Pa.
C. H. Smoot, Pres., Smoot Engineering Co., New York, N. Y.
J. E. Dunn, Comb. Engr., A. M. Byers Co., Ambridge, Pa.
I. M. Stein, Leeds & Northrup Co., Philadelphia, Pa.
C. L. Clapper, Brown Instrument Co., Pittsburgh, Pa.
W. M. Shallcross, Pres., Shallcross Control Systems, Inc., Milwaukee, Wis.
P. S. Dickey, Bailey Meter Co., Cleveland, Ohio.
R. W. Simpson, American Heat Economy Bureau, Inc., Pittsburgh, Pa.

SAFETY ENGINEERING DIVISION

EXECUTIVE COMMITTEE

Engineering Section Director

J. A. Oartel, Safety Director, Carnegie Steel Co., Pittsburgh, Pa.
Chairman, J. A. Voss, Safety Director, Republic Steel Corp., Youngstown, Ohio.
C. E. Sankey, Chief Safety Director, National Tube Co., Pittsburgh, Pa.
C. L. Baker, Management's Repr., Bethlehem Steel Co., Lackawanna, N. Y.
R. G. Adair, Asst. Works Mgr., American Rolling Mill Co., Butler, Pa.
Earl Blank, Director of Safety, Jones & Laughlin Steel Corp., Pittsburgh, Pa.
A. C. Germain, Safety Director, Minnesota Steel Co., Duluth, Minn.
H. G. Hensel, Safety Engr., Youngstown Sheet & Tube Co., Indiana Harbor, Ind.
F. H. Rowe, Safety Engr., Wheeling Steel Corp., Portsmouth, Ohio.
P. F. Haberstick, Safety Engr., Wheeling Steel Corp., Wheeling, W. Va.
P. G. Fenlon, Safety Director, Carnegie Steel Co., Duquesne, Pa.
J. F. Hunter, Safety Engr., Carnegie Steel Co., Pittsburgh, Pa.
F. H. Kittredge, Elec. Supt., Illinois Steel Co., Joliet, Ill.
Stanley Grand Girard, Chief Elec. Engr., Sharon Steel Hoop Co., Sharon, Pa.
G. A. Lamberton, Gen. Foreman, National Tube Co., Lorain, Ohio.
W. B. Payne, Chief Elec., Carrie Fces., Carnegie Steel Co., Rankin, Pa.
J. A. Northwood, Supt. Personnel, Bethlehem Steel Co., Sparrows Point, Md.

LUBRICATION ENGINEERING DIVISION

EXECUTIVE COMMITTEE

Chairman, C. C. Pecu, Lubr. Engr., Bethlehem Steel Co., Lackawanna, N. Y.
Secretary, T. B. Little, Association of Iron & Steel Electrical Engineers, Pittsburgh, Pa.
A. D. Adams, Asst. Supt., Spang Chalfant and Co., Inc., Ambridge, Pa.
D. B. Geeseman, Gen. Mgr., Standard Tin Plate Co., Canonsburg, Pa.
J. A. Clauss, Chief Engr., Great Lakes Steel Corp., Ecorse, Mich.
Vic Chartner, Chief Engr., Pittsburgh Steel Co., Monessen, Pa
J. D. Kelvie, Chief Elec., Republic Steel Corp., Massillon, Ohio.
J. H. Krehl, Supt. Mech. Dept., Youngstown Sheet & Tube Co., Youngstown, Ohio.
C. A. Bollinger, M. M., American Sheet & Tin Plate Co., New Castle, Pa.
F. J. Binckes, Asst. Chief Engr., Inland Steel Co., Indiana Harbor, Ind.
C. A. Baumann, Chief Mech. Engr., Carnegie Steel Co., Clairton, Pa.
H. R. Gilchrist, Lubr. Engr., Carnegie Steel Co., Youngstown, Onio.
J. C. Green, Asst. Engr., Pittsburgh Crucible Steel Co., Midland, Pa.
F. L. Gray, Lubr. Engr., Illinois Steel Co., Gary, Ind.
C. W. Phillips, Gen. M. M., Republic Steel Corp., Warren, Ohio.
F. C. Hallmark, Gen. M. M., Wheeling Steel Corp., Steubenville, Ohio.
H. G. Gibson, Chief Engr., McKeesport Tin Plate Co., McKeesport, Pa.

C. J. Duby, Asst. Chief Engr., Republic Steel Corp., Warren, Ohio.

Gordon Gage, Plant Engr., American Rolling Mill Co., Butler, Pa.

Carl S. Walrab, M. M., Calumet Steel Co., Chicago Heights, Ill.

L. A. Wynd, M. M., Keystone Steel & Wire Co., Peoria, Ill.

J. M. Faris, Asst. to Vice Pres., Youngstown Sheet & Tube Co., Youngstown, Ohio.

E. C. Kirkpatrick, Mech. Engr., Steel Company of Canada, Ltd., Montreal, Quebec, Canada.

L. F. Coffin, Gen. M. M., Bethlehem Steel Co., Sparrows Point, Md.

S. N. Roberts, Mech. and Elec. Supt., Atlantic Steel Co., Atlanta, Ga.

R. C. Mohler, Distr. Engr., American Steel & Wire Co., Pittsburgh, Pa.

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Practical Design and Application of Resistors for D. C. Motors*

By DON L. ORTON,
Application Engineer, The Clark Controller Company, Cleveland, Ohio

Practically all industrial plants accumulate, over a period of years, numerous resistor units and banks which very frequently represent the only salvageable part of a worn out or obsolete controller. Very often these resistors are charged to the Electrical Department as an inventory expense while they lie forgotten in some remote corner of the Electric Shop. The value of these units as spares to existing banks of similar make is undisputed but it is on new applications that the greatest opportunity exists to reduce this inventory expense.

During the past months of retrenchment and curtailed expenses the resourcefulness of the electrical engineer has been strained to the utmost. Very often it has been necessary for him to remove the motor and control apparatus from an abandoned drive and fit it to an entirely new application possibly requiring an entirely different duty cycle. Changes in the wiring of the controller are often necessary to meet new conditions and to incorporate such features as armature shunt slowdown, offpoint dynamic braking, speed control, etc. Changes of this nature usually require a reconnected resistor and possibly the addition of a new bank which often can be taken from the Electric Shop stock.

It is the intent of these two articles to provide the Plant Engineer or electrical engineer with sufficient data in the nature of methods, formulas, short cuts, etc., to enable him to properly apply and reconnect existing and stock resistors to new drives and applications. A thorough understanding of the principles set forth will be found useful in making resistor adjustments to existing drives required by changed conditions. Load conditions will be discussed at some length since these conditions bear a close relationship to resistor design. A knowledge of the fundamentals of Electricity is assumed and involved mathematics is omitted entirely. No space will be devoted to a discussion of the merits of the various types of resistor materials being marketed today as all plants have ample opportunity, by means of test, to determine the most desirable type of resistor for their particular operating conditions.

All resistors have two inherent characteristics, a knowledge of which is essential for correct application. They are ohmic resistance and thermal capacity. The ohmic value of a given resistor can be determined by simple shop tests if this data is not included on the manufacturer's nameplate. If a Wheatstone Bridge is not available the ammeter-voltmeter method may be used with sufficiently accurate results obtained for most resistor applications.

* This is the first of two articles by this author. The second one will appear in a later issue.

However, in regard to thermal capacity a little more difficulty is encountered. Thermal capacity may be defined as the ability of a resistor to dissipate energy in the form of heat. Some types of resistor materials have very high thermal capacity, that is, ability to dissipate heat very rapidly and therefore, can handle successfully intermittent current peaks many times their continuous rating. Tests and experience show that the average resistor will approach its limiting temperature if connected in a circuit for four minutes and this time period is therefore taken as the basis for expressing the degree of intermittency. The curves given in Figs. 1 and 2 are typical and represent the permissible loading of two particular types of resistor material. It has been agreed that the limiting temperature rise for resistors shall not be greater than 350°C. (embedded type 250° C.) and the two curves are plotted on this basis. The abscissa represents the time on period for each four minutes and the ordinate represents the percentage of continuous rating. Fig. 1 is plotted from a test of one particular type of ribbon wound resistor material and Fig. 2 represents cast iron grid practice for one certain rating. Thermal capacity will usually be different for various sizes of units or grids of the same material. Tests

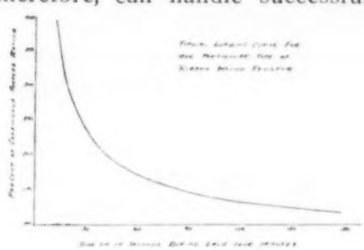

FIG. 1

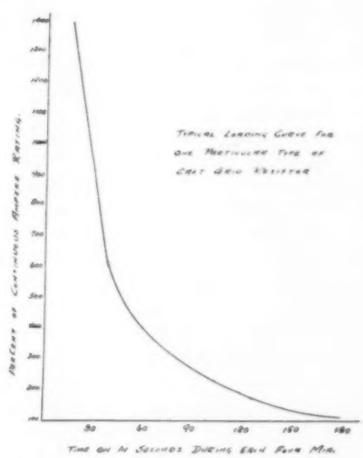

FIG. 2

Percent of full-load current on first point	Starting torque in per cent of full load torque.				Resistor class numbers				
					Starting duty		Intermittent		
	Series motor	Compound motor, 30% series	Shunt motor	Wound rotor induction motor	Light, 15 sec. in 4 min.	Heavy, 30 sec. in 4 min.	Light, 1 min. in 4 min.	Heavy, 2 min. in 4 min.	Continuous
25	8	12	25	.....	11	31	51	71	91
50	30	40	50	30	12	32	52	72	92
70	50	60	70	50	13	33	53	73	93
100	100	100	100	100	14	34	54	74	94
150	170	160	150	150	15	35	55	75	95
200	250	230	200	200	16	36	56	76	96

CLASSIFICATION TABLE OF ACCELERATING RESISTORS

FIGURE 3

can readily be made and curves, similar to Figs. 1 and 2, can be plotted for any given resistor. If the units or grids are to be closely stacked or ventilation liable to be restricted the intermittent rating should be reduced accordingly.

Probably the most frequently encountered resistor problem is that of accelerating a Direct Current motor and this problem lends itself to a very simple solution by the application of Ohm's Law. However, before attacking this problem it is necessary to consider the two chief characteristics of a resistor, referred to above, and their bearing on the drive to be accelerated. For the purpose of classifying accelerating resistors the Electric Power Club (now the National Electrical Mfgs. Association) have prepared a table assigning definite classification numbers to resistors. This table is reprinted here as Fig. 3, and it will be noted that resistors are classified with respect to the percentage of full load current inrush they allow and the approximate duty cycle or time in which they are in the circuit. Added to this

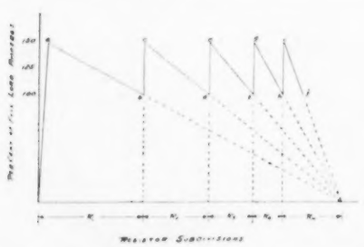

FIG. 4

table are four columns of starting torque values expressed as a percent of full load with values named for all resistor classifications. A class 35 resistor is designed for heavy starting duty (30 seconds on out of four minutes), has proper ohmic value to allow an initial inrush current 150% of full load current, will allow a series motor to exert approximately 170% of full load torque and a shunt or wound rotor motor approximately 150%.

The first step in the problem of applying accelerating resistors to Direct Current motors is to decide what resistor classification the drive demands. Experience has proven that satisfactory acceleration is obtained with magnetic controllers on the following typical drives using resistor class numbers included in the list:

Centrifugal Blowers ..... Class 34
Belt Conveyors ..... Class 35.
Vertical Mine Hoists ..... Class 73.
Constant Speed Compressors ..... Class 35.
General Service Cranes:
Bridge ..... Class 53. (Class 54-Man. Control)
Hoist ..... Class 52D.
Trolley ..... Class 53.
Slope Hoists ..... Class 72.
Machine Tools, such as:
Lathes, Drills, Boring Mills, Presses,
Saws, etc ..... Class 35.
Paper Calenders ..... Class 54.
Centrifugal Pumps ..... Class 34.
Plunger Pumps ..... Class 35.
Heavy Duty Cranes:
Bridge ..... Class 54. (Cl. 54P-Man. Control)
Hoist ..... Class 72D.
Trolley ..... Class 53 (54P-Man. Control)

The letter (P) or (D) added to the Class number indicates that additional capacity should be allowed respectively for plugging or dynamic lowering. The above list is by no means complete but it is intended to indicate resistor class numbers that have proven satisfactory on typical drives.

Once the resistor class number has been decided the correct ohmic value is readily determined by means of Ohm's Law. Suppose we have selected a light duty class 15 resistor to accelerate Direct Current Motor (shunt, series or compound wound)—the rule becomes:

$$R = \frac{E}{1.50 \times I.} \div 1.15$$

Where:

R = ohms in resistor
E = line voltage
I = full load current of motor.

Had we selected a class 13 resistor the constant in the denominator would become .70 instead of

1.50. The constant 1.15 is included to compensate for the resistance and reactance of motor and leads. The capacity of the resistor has been discussed in previous paragraphs, and tests to determine whether a given bank will successfully handle a certain current cycle can be made.

Up to this point we have determined the total ohmic resistor and it now becomes necessary to proportion this total into the number of steps required by the controller with which it is to operate. The solid lines of Fig. 4 represent the theoretical ideal conditions of acceleration. This curve is based on a resistor having four divisions, the abscissa representing total resistance subdivided into steps (R^1, R^2, etc.) and the ordinate representing current drawn by the motor in percent of full load. Rm represents the resistance of motor and leads. This resistor is designed to allow an initial inrush current of 150% which is graphically represented by point *a* on the curve. The motor accelerates and the armature current declines to the point representing full load current. At this point the first accelerating contactor closes and if resistor section R^1 has been correctly proportioned the second inrush current peak will also equal 150% of full load current and be represented by point *c* on the curve. The motor continues to accelerate and at point *h* the final accelerating contactor closes and the motor is connected across the full line voltage. Another inrush current peak takes place to point *i* and the motor settles down to its normal running load somewheres near point *j*.

It is possible to represent mathematically the relationship pictured by the curve of Fig. 4 and thus determine the exact percentage of the total ohms best suited for each individual step. However, in view of the many factors influencing motor acceleration exact calculations are not ordinarily attempted. Certain values necessarily assumed for the purpose of mathematical analysis will vary widely under actual operating conditions. The proportioning is now fairly well standardized and based upon tabulated values. Those given in the Table Fig. 5 —representing average practice. A resistor used to accelerate a shunt wound motor and in connection with a controller equipped with four accelerating contactors would have its four divisions proportioned as follows:

1st—46% of total ohms
2nd—27% of total ohms
3rd—17% of total ohms
4th—10% of total ohms

It will be noted that the proportions differ in the case of shunt and series motors due to the fact that in the latter type the counter voltage increases to some extent with the current inrush at each step caused by the increase in field ampere turns. The determination of the number of resistor divisions and accelerating points is strictly a motor and control problem and will not be discussed here.

It is standard practice among designers to taper the steps of an accelerating resistor and although this is considered to be a problem of judgment and experience fairly definite rules can be set down to simplify the procedure. A study of the application will show the approximate number of starts per hour that can be expected and knowing the time required to accelerate we can very easily calculate the time in each four minute period that the resistor will be in the circuit. That is, a drive started once every minute and controlled by a starter provided with four accelerating contactors timed at 2 seconds each will have a total accelerating period in each four minutes of 32 seconds. If an ohmic value is calculated to allow an inrush current of 150% full load this resistor becomes a class 35. However, the final resistor step is the only section of the total resistance actually in the circuit the entire 32 seconds. The first section (short circuited by the first accelerating contactor 2 seconds after the motor starts) will have a time-on period in each four minutes of 8 seconds, the 2nd step 16 seconds, the 3rd 4 seconds and the 4th 32 seconds. Since we have reasonably definite time-on values for each section of the resistor it is quite simple by referring to curves similar to Figs. 1 and 2, to determine whether a given continuously rated resistor unit or grid can be expected to satisfactorily handle the intermittent requirements of a certain drive.

For the purpose of practical calculation it is perfectly safe to assume the average accelerating current per step is equal to the average of the peak and valley current values. Referring to Fig. 4 the peak currents are represented by points *a, c, e, g, and i*—and the valley currents are represented by points *b, d, f* and *h*. The peak currents being 150% full load and the valley currents 100% we can assume the average accelerating current per step to be 125% of full load amperes. Thus knowing the time in which each step may be expected to be in the circuit and the average current it may be expected to carry during that time we can very readily select the proper continuously rated unit or grid required per step for any given drive.

The curve of Fig. 1 represents the practice of one particular manufacturer of ribbon wound resistor and Fig. 2 applies to a certain cast iron grid. Due to the wide variety of ribbon wound and various other types of unbreakable resistors now on the market it is recommended that in applying this type of resistor the test methods referred to earlier in this article be carefully used to determine current capacities. Most manufacturers of unbreakable resistors will gladly supply data to assist the operating man in applying their particular material to intermittent services such as that we have been discussing.

In the foregoing discussion covering accelerating resistor it has been assumed that the connections would be of the ordinary series type where connections are such that the entire resistor is in series with the armature at the moment of starting and sections are short circuited as the motor accelerates. Other connections are possible and sometimes used on very special applications such as inserting one section in series with the armature at start and subsequently paralleling additional sections as the motor accelerates. However, the straight series method is almost universally used and therefore our discussion will be limited to that particular type of connection.

At this point it is logical to consider resistors for plugging service, this type of service being defined briefly as the act of reversing the polarity of an armature before rotation in the initial direction has ceased. The series accelerating resistor is of course, inserted into the circuit but due to the fact that the counter voltage of the motor adds to the line voltage

until armature rotation has reversed it is necessary to provide additional ohms in the series resistor to limit the plugging inrush current peak. The series accelerating resistor should be determined by the method prescribed above. To this will be added the plugging resistor, the ohmic value of which will depend upon the counter voltage at the instant of plugging and the allowable inrush current. The allowable inrush current during plugging is commonly taken to be the same value as that used in calculating the accelerating resistor. For practical purposes the counter voltage may be assumed to equal 90% of line voltage and if the allowable inrush current used to determine the accelerating resistor is 150% full load amperes the formula to determine the plugging resistor section is:

$$R = \frac{.90 \times E}{1.50 \times I} \div 1.15$$

Where:

R = ohms in plugging section
E = line voltage
I = full load current of motor.

If the drive requires that the motor be plugged at each operation the capacity of the plugging step may very safely be taken as the same as the first step of the accelerating resistor. However, if the motor is plugged very infrequently such as for emergency stop the capacity may be somewhat less than the first accelerating section. In applications of this nature the next lower rated resistor unit or grid to that decided upon for the first accelerating section will be ample.

In calculating resistor for dynamic braking the procedure is very similar to that outlined above for plugging service. Here again the ohmic value depends upon the counter voltage of the motor and the allowable current inrush peak. For rapid stopping dynamic braking is very frequently used and is simply the connecting of a resistor directly across the armature with the motor disconnected from the line with the exception of the field which remains energized. By this means the rotating energy of the armature is quickly dissipated in the resistor and the motor is rapidly brought to rest. The allowable inrush current peak is most generally taken, on single step dynamic braking resistor, to be greater than that allowed for accelerating, most motor designs permitting 200% of full load amperes. The counter voltage of the motor may again be assumed to be 90% line voltage and the formula given above for plugging resistors may be applied except substituting the constant 2.00 in place of 1.50 in the denominator of the fraction. This new constant being included regardless of the class number of the accelerating resistor and is the value most frequently used by designers. For the purpose of determining capacity the average dynamic braking current can be taken as equal to 40% of the inrush peak which as stated above is most frequently twice full load current of the motor. A knowledge of the drive will generally indicate the approximate number of stops that can be expected in each four-minute period and the approximate length of time the dynamic resistor will carry current. By applying curves or test methods previously referred to the continuously rated unit or grid best adapted to the job can easily be selected.

On certain special applications graduated dynamic braking is advisable whereby some means is provided by the controller to short circuit sections of the dynamic braking resistor as the motor decelerates. This requires the resistor to be subdivided and the values given in the table of (Fig. 5) for proportioning accelerating resistors may be used for practically all application. A dynamic resistor so proportioned will give satisfactory operating characteristics. Regarding current carrying capacity we encounter considerable difficulty in attempting to ascertain the current conditions at each step. Due to the many varying conditions, calculations are not ordinarily attempted but the following method may be used in all cases. Compute total ohmic value and subdivide according to Fig. 5. Consider 40% of inrush peak current to be average value during dynamic braking. From duty cycle compute time on during each four-minute period and from curves or test determine the correct size continuously rated unit or grid for the service. Use the size just selected for the final step (the section to be short circuited last) and taper back dropping down to the next lower continuously rated unit or grid at each step. For instance on a four step graduated dynamic braking resistor the fourth step might con-

FIG. 5.

Number of steps	2		3		4		5		6	
Type of Motor	Shunt	Series	Shunt	Series	Shunt	Series	Shunt	Series	Shunt	Series
Step 1	70%	58%	54%	41%	46%	32%	42%	26%	35%	22%
2	30	42	30	33	27	27	26	22	24	20
3			16	26	17	22	16	20	17	17
4					10	19	10	17	11	15
5							6	15	8	14
6									5	12

TABULATION SHOWING PERCENTAGE OF TOTAL RESISTANCE PER STEP.

sist of 72 ampere continuously rated units, the 3rd step 69 ampere units, the 2nd step 55 ampere units and the 1st step 50 ampere units, there being no intermediate sizes between the 72 ampere, 60 ampere, 55 ampere, or 50 ampere ratings. Without the use of involved calculations incorporating numerous questionable assumptions this method is the most economical and practical procedure. All of the comments and methods outlined concerning dynamic braking assume a shunt or compound wound motor being used with constant normal shunt field during the dynamic braking period.

If dynamic braking be applied to a straight series motor some means must be provided to externally energize the series field, usually accomplished by connecting it across the line through suitable resistance to limit the current. This affects the dynamic braking resistor only to the extent that it influences the counter voltage at the instant we apply the braking. If the series field is across the line with sufficient resistance to reduce the current through it to full load value then the procedure given above for shunt and compound motors apply. However, should the resistor limiting the current strength of the series field allow—say—150% full load current to flow, the counter voltage will likewise be increased in the same ratio at the instant we apply the braking. If the series field is across the line with sufficient resistance to reduce the current through it to full load value then the procedure given above for shunt and compound motors apply. However, should the resistor limiting the current strength of the series field allow say 150% full load current to flow, the counter voltage will likewise be increased in the same ratio at the instant dynamic braking commences. In this case, in order to stay within the limits of allowable current inrush, we must increase by 50% the ohmic value obtained by methods given above for shunt or compound motors. Off-point dynamic braking is very rarely applied to series motors in present day control practice.

Dynamic braking of an entirely different sort is applied to modern up-to-date hoisting equipment, this feature of operation frequently referred to as dynamic lowering, regenerative braking, etc. Series wound motors are universally used on drives of this type—such as a crane hoist—and on modern equipment means are provided in the control to restrict the lowering speed which obviously would become excessive due to the inherent speed-load characteristic of this type of motor. Very rapid progress has been made by control manufacturers in the development of this type of equipment and numerous schemes are available each incorporating features of operation recommended by the particular manufacturer. In general the control reconnects the motor during the lowering period with field of correct value maintained by connecting it across the line through a resistor which is adjusted to the desired speed. Thus we have—in effect—a shunt wound motor the speed of which is varied at will by adjusting the field. During hoisting standard series motor connections are made. For a simple dynamic lowering connection three resistor banks are required. One being in series with the field of the motor and both connected across the line during lowering, one in series with the armature during both lowering and hoisting, and a resistor connected into a circuit at the off-point consisting of the armature and series field as a safety feature to very gradually lower the load should the magnetic brake fail. Due to the extremely large number of dynamic circuits and schemes being offered by the various control manufacturers today it is not feasible to attempt to outline a method for calculating resistors that would apply even in a general way to all dynamic lowering schemes.

As we continue with our general problem of resistor design, we encounter the question of speed control and from here on the discussion will include methods useful in computing and selecting resistor for this class of service. It is of prime importance to consider first the characteristics and load requirements of various types of drives. Based on speed, load requirements there are three fundamental types of load, viz: Constant torque, constant horsepower and variable torque.

In this discussion a fundamental relationship must be constantly borne in mind, viz: that horsepower is always proportional to the product of speed and torque.

A typical constant torque drive is a belt conveyor wherein the major portion of the load consists of friction, the torque requirements of which remain practically constant throughout the speed range. A metal lathe is a typical constant horsepower drive since the torque required depends entirely upon the cut being taken which in turn depends upon the speed. The greater the speed the less the cut and the product of speed and torque remains constant for practical purposes, hence constant horsepower.

An example of a variable torque drive is a centrifugal fan where, on sizes 18 horsepower and up, the torque required by the load varies directly as the square of the speed. Doubling the speed, therefore, increases the actual horsepower load eight times and the horsepower thus varies as the cube of the speed. An example will make this clear. The formula for expressing horsepower in terms of torque and speed is as follows:

$$\text{Horsepower} = \frac{\text{Torque} \times \text{RPM}}{5250}$$

Let us assume a 20 H.P. motor whose full load speed is 600 RPM, and whose full load torque will be 175 pound feet. Suppose we double the speed, the torque required by the load will increase four times since torque required varies as the square of the speed. We have multiplied the speed by 2, the square of 2 is 4, and we must therefore, multiply the torque by 4. This gives us a new speed value of 1200 RPM and a new torque value of $4 \times 175 = 700$ pound feet. Substituting these values in the above formula we arrive at a horsepower for double speed as follows:

$$\text{Horsepower} = \frac{700 \times 1200}{5250} = 160 \text{ (at 1200 RPM)}$$

This relationship does not, however, hold true on the smaller sizes. Up to and including 5 H.P. the torque required is directly proportional to speed, from 6 to 17 H.P. inclusive the torque required varies midway between a direct ratio and the square of the speed, and on sizes 18 H.P. and up the torque required varies directly as the square of the speed range.

Speed Control of direct current motors by

means of resistance connected in series with the armature is very frequently resorted to in spite of two series disadvantages. These two disadvantages are—wastefulness and poor regulation. Occasionally, however, the method is justified to reduce the base full field speed of an existing shunt or compound motor driving a load that due to changed conditions requires a slower speed. Very often a motor is transferred from one application to another, the new drive necessitating a lesser speed than the motor was originally designed to produce. It is sometimes desirable to obtain a specified speed range partly by means of shunt field adjustment and the balance by means of series armature resistance. Due to the I^2R losses in the series resistor, the efficiency of this type of control is very poor and the method is quite wasteful of power. Furthermore, any change in the speed due to the variation in voltage drop across the series resistor is reflected by the load.

In attacking a problem of this general nature, it is first necessary to consider the characteristics of the driven machine to determine whether it is of the constant torque, constant horsepower or variable torque type. Let us take for example a belt conveyor (constant torque drive) operated by a shunt wound motor designed for a given base speed. Because of a change of material being handled or an alteration of the unloading conditions it might become necessary to reduce the original speed of the motor. The practical expedient in a case of this kind is series armature resistance since it is never advisable and most frequently impossible to change the field structure of a given motor to reduce the full field speed. Our belt conveyor has been defined as a constant torque drive (constant torque required regardless of speed change) and since we have selected a shunt wound motor for our example the field strength will likewise remain constant if we are to reduce the speed below the base full field value.

The developed torque of a motor may be expressed as follows:

$$T = k\Phi I$$

Where:

T = Torque
Φ = Field Strength
I = Armature Current
k = A constant depending upon motor design

Therefore, in our belt conveyor example, since T, k and Φ remain constant regardless of speed change we arrive at the conclusion that I must also remain constant. It is important that this relationship be remembered and this can be expressed as follows:

> On any contant torque application the speed of which is adjusted by means of series armature resistance (the field strength remaining constant) the ampere current drawn by the motor will remain practically constant throughout the speed range.

With the conditions as described above, viz: constant torque, constant field and constant current, the motor speed will vary in a practically direct ratio with the voltage applied to the armature. The line voltage is a fixed value and since the armature voltage is readily determined by the desired speed reduction the series armature resistance must be designed to give a voltage drop equal to the difference between line and armature voltages. This can be represented algebraically:

$$R = \frac{E - e}{I}$$

Where:

R = ohmic resistance of series resistor
E = line voltage
e = armature voltage for desired speed reduction
I = load current of motor.

Let us assume our shunt motor has a full load current of 40 amperes, the line voltage to be 230, and it is desired to reduce the speed to 50% of its full field speed. Since the armature voltage bears a direct ratio to the desired speed reduction, 50% in this case, we will require a voltage across the armature 50% of normal or 115 volts. The armature current of 40 amperes remaining the same at both the high and low speed points we have only to substitute in the above equation—thus:

$$R = \frac{230 - 115}{40} = 2.88 \text{ ohms in series resistor for 50\% speed reduction.}$$

The capacity of this resistor must necessarily be 40 amperes continuously since this current will be carried at all times while the motor operates at reduced speed. The 40 ampere current value assumed in the above example should represent the load current at the full field base speed which can be very readily measured by means of an ammeter.

Convention and Exposition R. R. Certificates

The Railroad Identification Convention Certificates for use in attendance at our Convention and Exposition to be held in Hotel Wm. Penn, Pittsburgh, Pa., October 17, 18, 19, 1933, are now available at the home office of the Association. The holders can use the same certificate to bring their families as well as themselves at the rate of one and one-third fare for the round-trip—minimum fare $1.00, and the tickets can be purchased from October 13th to October 19th. Stop-over privileges can be arranged if desired, also a diverse route can be used for the return trip at no extra cost. These tickets are good for a thirty day period from date of sale, and the return trip may be started any time within this period beginning October 17th, 1933, however, all tickets must be presented at regular R. R. ticket office in Pittsburgh and be validated before they can be used for the return trip. We hope with this attractive rate and desirable terms that many will take advantage of this opportunity to come to Pittsburgh at this time. In case you desire certificates please let us know as soon as possible, addressing A. I. & S. E. E., 1010 Empire Building, Pittsburgh, Pa.

Steel Mill Lubrication—Its Relation To Safety and Economy

By E. A. HARPER
Chief Engineer, The Texas Co., Birmingham, Ala.

Presented before Birmingham Section of A. I. & S. E. E., March, 1933.

Lubricant Cost is equivalent to the number of cents per pound, per gallon or per ton of steel rolled. It includes the actual cost of the lubricants plus taxes of any sort, and handling charges to, and including storage in supply house or other suitable place.

Lubrication Cost, however, covers a far greater scope. It can truly be said to be connected with, sometimes dependent on, and invariably of vastly greater importance than lubricant cost. It involves, among other things, maintenance, depreciation, labor cost, personal safety, and therefore bears a direct relationship to a concern's competitive ability.

Frequently, it has been found that the lubricants whose cost per gallon or pound were very nominal while actually keeping machinery operating in an apparently satisfactory manner were, in reality, unsuited from an operating cost standpoint, for the job to which they were being applied. This is due often to the excessive amount required.

Misapplication of the proper Lubricant or any sort of application of an improper lubricant often causes conditions which, if not corrected, can and have often been the source of disastrous repair and production difficulties.

In support of the afore mentioned, I offer the following: A's Gear Lubricant when applied to a set of exposed gears on a table drive would remain or stay put, as it is called, for a period of 24 hours, under normal operations. It would not throw off, dirtying up the surroundings. B's Gear Lubricant was applied in like amount and under like conditions of operation required an application every 12 hours in order to preserve the protecting film. Product A cost ½c per lb. more than did Product B, however, it requires very little mathematical calculation to determine that Product A at ½c more per lb. was substantially cheaper from an operating cost standpoint.

Another example, in recent years, an enclosed gear set was installed in connection with the main hoist at a mine in a certain ore field area. At the time of installation a certain Lubricant was applied in exactly the right manner and when the set was started up, readings taken over a period of 24 hours, indicated a very nominal temperature rise of five degrees over atmospheric. Several months later the gear case was drained and workmen refilled same using the very same grade and trade name of Lubricant as was applied originally. Upon starting up the gear set immediately built up an exceptionally high temperature, which temperature was in fact sufficient to cause the bearings to heat up noticeably.

Investigation developed the fact that the level of the Lubricant in the gear case was so high that the bull gear was agitating it to such an extent as to cause it (the Lubricant) to heat up, thus transmitting temperature to all parts of the gear set and also interfering with the proper picking up of Lubricant by the gear teeth. This permitted theoretically, a certain amount of metal to metal contact which caused more heat due to metallic rubbing and thus building up a vicious and endless cycle which was eliminated only by removing the excess amount of gear Lubricant. When this was done the gear set soon returned to its normal operating temperature and no further difficulty was experienced. The above refers, of course, to a splash or bath Lubricated gear.

In connection with the above, it is deemed advisable to mention that experience has proven that the more attention given to gear case design to the end that a very minimum amount of Lubricant is required to maintain proper depth, the better will be the results.

In this respect, for best results, the distance between the inner side of the gear case and the bottom of the bull gear should be between one-quarter inch and one-half inch. The depth of the Lubricant in inches would then depend upon the depth of the tooth of the bull gear.

In a certain plant in the Birmingham area, a tube mill girth gear had to be renewed at about eight month intervals, due to excessive tooth wear. This gear was, of course, of an exposed type and was subjected to appreciable amounts of grit and other foreign matter. Special consideration was given this problem by the lubrication engineers of one of the petroleum products companies and the lubricant supplied which, when applied properly, formed a very tough coating supplying sufficient resistance to tooth pressures, at the same time being of such nature as to prevent the grit and other foreign matter adhering to the teeth, and thereby damaging the gear.

Since being so treated, this girth gear has actually operated in excess of 24 months and bids fair to continue for at least that much longer.

Still another example of expensive lubricant and maintenance cost is brought to mind in a certain mill drive wherein cost of lubricant per gallon was given prime consideration in spite of the fact that this heavy duty gear set was so designed as to use the same Lubricant on both the gears and the bearings. In this particular instance, where design enters into the problem the cost of lubricant should be properly of secondary consideration. In operation, frequent changes and additions of lubricant were required but in spite of this, undue wear has appeared. Of course, had the gear set been designed for grease or other individual lubrication of the bearings, and a separate lubricant being used for

the gears themselves, the problem would have been very simple. As it was, only the highest quality straight mineral lubricant of proper viscosity should have been used. Such a Lubricant should have possessed the property of quick separation when subjected to water accumulations which were due to condensation.

These examples and others which could be enumerated to an almost limitless number, can be said to substantiate the assertion that Lubricant cost is of little or no importance as compared with Lubrication cost. This latter in the interest of economy, safety, etc., should be given preferred consideration in favor of the prime and major importance of production costs as related to Lubrication.

While Lubrication costs, maintenance costs, production costs, etc., are of prime consideration in these severely competitive times, the matter of personal safety should be given equal or greater consideration.

If a piece of machinery is properly lubricated, properly maintained and kept clean, there is far less likelihood of a workman meeting with an accident while working about the machinery. This is especially true in regard to over-head traveling cranes and all movable equipment; it is applicable likewise to all other machinery where men are working around and about.

If excess quantities of the proper Lubricant are applied the excess amount is likely to be thrown off and an objectionable accumulation builds up. If an improper Lubricant is applied in any amount the same thing is likely to occur and a workman may slip and injure himself seriously or even fall to his death.

Overhead traveling cranes have in years gone by been the scene of many fatal accidents, a large portion of which could justly be attributed to negligent handling of lubricants, thus permitting of accumulations which, when stepped on by a workman unthinkingly, caused him to fall with frequently fatal results.

If the Safety movement in our mills and factories is to be of utmost value, we cannot afford to overlook the importance of proper handling of Lubricants, and the proper application, and of equal importance is the right Lubricant for the job.

From the foregoing, it will be recognized by all present, that too much stress cannot be laid upon the matter of proper lubrication and cleanliness as regards production cost, taking into consideration the feature of personal safety.

The matter of cleanliness in regard to Lubrication is important from a maintenance standpoint as well as a safety standpoint. When mill scale and dust or other foreign matter is allowed to accumulate around a bearing housing, especially if it be oil lubricated, a small portion will invariably work into the bearing, which will ultimately cause difficulty, frequently entailing expensive repairs or possibly a larger loss from a production standpoint.

Considerable thought should at all times be given to the matter of cleanliness of machinery from a maintenance standpoint and this, of course, calls for consideration of the right lubricant and the proper application.

Frequently, it has been found that a piece of machinery originally intended by the builder to be lubricated with oil has been far more satisfactorily and economically lubricated with grease, especially in the case of heavy duty, slow and moderately slow moving machinery. Very often such a change will be accompanied by less drippage and the area adjacent to the bearing being much cleaner and more easily kept so, the personal hazard that would otherwise be present to a large degree is practically eliminated.

For reasons of economy there is a certain trend in some types of Industries toward the use of Grease. In this connection the favorite method of application seems to be by the so-called centralized or pressure systems of either the automatic or manual type. As most everyone present is more or less familiar with this type of application, very little consideration will be given to it here. Before passing, however, it is felt that it would not be out of order to mention a few of the features that have been found admirable and which it is reasonable to expect in an automatic pressure grease system. Among these, are reasonable first costs, moderate installation costs, starting and stopping functioning, simultaneously, with the starting and stopping of the machinery served, positive operation at all times, low maintenance cost, positive indication every time an outlet discharges and every outlet to capable of adjustment entirely independent of any other outlet. Ability to carry out the above over a range of greases extending from liquid and semi-liquid on to a consistency, having a moderately low penetration number, is also an advantage.

Great strides have been made in recent years as regards improved methods of application of Lubricants, both oil and grease. This is noticeable in the later pinion stands, which are provided with circulating Lubricating systems and in the pressure systems now available for the application of softer greases.

It can be said in favor of any of the modern grease and oil systems that, when properly installed, properly adjusted, and if dispensing a lubricant suited to the requirements of the job, lubrication and maintenance cost will be kept at a minimum and depreciation lowered as well as personal safety greatly enhanced. What other action will go farther toward keeping total production costs at the low point present-day competition and regard for personnel safety requires?

In connection with maintenance, replacement and safety around the steel mill, too little thought is generally given to Lubrication of wire cables such as are used on crane trolleys and similar places throughout the plant. These cables are expensive and unless properly protected require frequent replacement, otherwise, fatal accidents as well as expensive shutdowns are likely to occur. If these cables, when built, are laid up in a high grade wire rope dressing and after being placed in service are cleaned and coated at intervals with a high grade preservative, their life will often be lengthened from one to several hundred per cent.

Frequently it will be noticed that Lubricant is being thrown out around the shaft where a ball or roller bearing is in use. Almost invariably investigation shows that it is a case of excessive application. It is true, of course, that relatively the same thing can happen where an improper Lubricant is applied. On a whole, however, more difficulty arises from

excessive application than any other one cause pertaining to Lubrication as regards anti-friction bearings. Experience teaches that most anti-friction bearings perform entirely satisfactorily when the housing is approximately one-third full. There are, of course, exceptions to this rule as well as to most all others. In the case of a special condition, it is well to be governed by the recommendation of either the manufacturer, his field engineer or a reliable Lubricating Engineer.

Increase in the size and speed of certain types of machinery during the past few years has developed a new requirement so pertinent to bearing construction as to necessitate radical changes in design and methods of Lubrication. More than ever has the need for positive and dependable Lubrication become apparent. This has required numerous changes in bearing seal construction and increase in the load carrying capacity of Lubricants. Of chief interest, however, has been the transition from the traditional plain or sleeve type bearing to the anti-friction bearing. Developments in this regard have been especially extensive in the iron and steel industry.

The problems pertinent to the operations of steel mill bearings vary widely. Loads are frequently excessive, vibration is virtually continuous, and the prevailing shocks which result from impact of ingots, or billets, upon the roll surfaces react upon the roll neck bearing in practically any type of mill. The same holds true on ingot and charging car bearings. Unless the resultant loads can be readily carried by the bearing Lubricant, and unless there is adequate provision to prevent squeezing out of this latter, the life of the bearing will be markedly reduced. Somewhat similar conditions prevail in the operation of hot saws. Here, however, there is the added element of speed which, coupled with the severity of the load and the frequency with which it must be absorbed in its full intensity by the bearing, often subjects the saw mountings to duty so severe as to materially reduce their effective life.

But load, shock, vibration, speed and high temperatures are not the only factors which must be considered in a study of steel mill bearings and their Lubrication. One must realize that the contaminating effects of dust, dirt and water, as well as the abrasive nature of the former, may lead to impaired Lubrication and abnormal bearing wear. Obviously, protection of the surfaces of the bearings elements must be assured and any lack of protection in this respect will invariably react to the disadvantage of the equipment involved. As already stated, steel mill bearings will, in general be required to function under conditions decisively adverse to effective Lubrication. These conditions will include radiated and conducted heat, water plus entrained scale, and hardness of steel being rolled as well as speed of rolling. The load carrying capacity of the Lubricant is, therefore, quite as important as its temperature resisting ability and the demand for protection from foreign matter.

Selecting a Lubricant can be gone about in many ways. In order that best results may be obtained considerable thought is necessary. To illustrate a suitable procedure in connection with such a Lubricant selection, let us consider a worm gear.

In selecting a Lubricant for a typical worm reduction gear, there are certain definite properties which the product should in general possess if it is to function effectively. 1st—Sufficient Lubricating ability or Oiliness to insure reduction of both solid and fluid friction to a minimum. 2nd—Viscosity or body commensurate with the method of Lubrication and the amount of heat that may be encountered, such that a suitable film will be insured between the teeth as they become enmeshed, and the effects of both pressure and temperature resisted. Pressure, of course, exerts a squeezing out action, temperature renders a Lubricant more or less fluid, according to its degreee, for viscosity is reduced as temperature arises. 3rd—A sufficient degree of adhesiveness so that in event of use under exposed or semi-enclosed conditions a requisite film will remain on the teeth to resist the tendency of centrifugal force to throw it off. 4th—As little tendency as possible to congeal, harden, crack or become brittle, when used under lower temperature conditions or to carbonize and chip if exposed to abnormally high temperatures.

There is available to the trade today a suitable Lubricant for almost every requirement known to the petroleum industry. It is well to take this into consideration when maintenance and/or production costs are scrutinized from time to time and just as you would call on your doctor for advice regarding the human anatomy, so is it well to resort to the assistance of those whose job it is to prescribe for and supervise the Lubrication of machinery.

Many concerns purchase Lubricants on a so called specification. This often reacts to the purchaser's disadvantage due to the fact that frequently the specification set forth is not complete. To illustrate, a purchaser asks for an oil for an air compressor or other similar piece of equipment, giving the following requirements. Gravity, Flash, Fire, Viscosity, and Pour. Most any vendor could meet this specification and still not furnish a Lubricant of the quality generally accepted by the trade as being satisfactory for such a purpose. Had the requirements of the specifications included carbon content, and color, the picture presented the vendor who was going to supply the Lubricant would be entirely different. Each of the above items are dependent one on the other to a great extent.

Obviously, when purchasing on specification, too much care cannot be taken to assure that the specification covers fully each and every point that is required to make up an entirely satisfactory Lubricant. Even so, the best specification and the greatest assurance that a Lubricant is exactly what it should be, is the actual operating test of same. Very frequently, a Lubricant that has been in service giving entire satisfaction for an extended period, is replaced by another Lubricant supplied at a lower price and which the purchaser is assured complies with the specifications, either called for by the purchaser himself or by a comparative laboratory report. In a case of this sort unless the purchaser is thoroughly familiar with specifications and the reason for them, he is quite likely to cause to be placed in service a product which is not comparative to the entirely satisfactory product that he is displacing.

Each class of Lubricant is manufactured to a definite standard. When selecting by specification, it is of vital importance that those charged with this responsibility be thoroughly informed, otherwise, it is

quite likely to be altogether entirely unsatisfactory. It has often been said, that a little education is worse than no education whatsoever. This is especially true as regards Lubricants. In such a case, it is better to trust to the use of a recognized product that has met with acceptance from the industry involved.

In this connection it might be well to state that the manufacture of products in the petroleum industry is so standardized, as are the manufacturing methods in the steel industry, that very little differential in manufacturing costs between refineries can be noticed. Obviously, if quality of product is to be maintained, there is and can be very little difference in the price of the Lubricants, at the point of manufacture.

After having seen the necessity for real lubrication and lubricating efficiency, we are prompted to enquire "What Is Lubrication?" How can we be sure that the moving parts of our machinery are being properly lubricated? Lubrication may be defined as "The Right Application of Exactly the Right Amount of the Proper Grade of Lubricant to Each and Every Moving Part of the Machinery Involved." How can we be certain that we are accomplishing this? Your maintenance cost sheet is the place to look for it. If the proper supporting film is being supplied, metal to metal contact will be prevented and, therefore, metallic rubbing and wear will not be in evidence. If an excess amount is supplied it will be noticeable in its tendency to accumulate outside of the bearing. Therefore, the extreme importance of supplying exactly the right amount of the right Lubricant to each and every point involved cannot be emphasized too much.

In order that we may best serve our industry, our country, ourselves, and foster low production costs, let us remember that we must first purchase intelligently, store and handle intelligently, apply safely and economically, avoiding all losses in handling and all excess handling charges, then only will we approach economical Lubrication. If we do so, we will have attained the much desired Lubrication and maintenance economy and at the same time will have taken a long step toward the preservation of personnel safety and certainly will have assisted in keeping our total production costs at an absolute minimum.

The fore-going is a recital of facts with which you are all more or less acquainted. If I have called them to your attention in such a manner that you will use them to the best interests of your employers, my purpose will have been accomplished.

Co-operation—A National Necessity

BY GEORGE M. VERITY,
Chairman, American Rolling Mill Co.

We have only to go back far enough to find where society as a whole was divided into just two groups, Masters and Slaves.

That inhuman situation gradually gave way through the ages to a more modern civilization. Today we find an absolute reversal of the established policies of those tragic days of old.

Where even thirty years ago Hire and Fire was the theory back of employment, it was left to modern day industry to discover that its future lay in the development of the capacities and abilities of men, and in the creation and application of plans that would bring into life a spirit of mutual interest and co-operation between management and men.

That new spirit now prevalent throughout Commerce and Industry has revolutionized modern society.

Co-operation is not a new idea to this generation, and while it has been abused and much misused in many instances, the greatest marvels of science and industry are the products of its development; in other words, they are the result of a more perfect synchronization of the personalities, abilities and characteristics and ambitions of groups of men bound together by the ties of mutual interest. The automobile, the radio, the airplane and all modern household equipment are the products of co-operating groups.

In present day organization men do not spend their time in endeavoring to arbitrate their differences of opinion or to bargain about their individual interests. Their minds and hearts and hands are completely occupied in making their largest possible contribution to the common good of the organization to which they belong. They learned long ago that no group can get out of any business adventure any more than they put into it.

Modern business needs the best that men can do; it has therefore endeavored to provide every possible practical incentive and every possible reward for that sort of loyal effort that makes for complete and successful co-operation. This has been accomplished in a degree unbelievable just a few short years ago.

In every soundly organized industry men are considered of greater value than any other factor necessary to successful operation, and through the development of mutual interest and co-operative plans they are bound together in one cohesive group which stands foursquare and courageously faces every obstacle and every difficulty that presents itself. Present day accomplishments would not have been possible in any other way, there could not have been even a beginning.

There can be no divided interests in an organization that fully responds to all these known developments. Present day industry is fundamentally very much like a modern army which knows instinctively that it must act as one man in its own salvation, as well as in support of the cause for which it contends.

DISTURBING ELEMENTS

In spite of all these known facts and conditions there are individuals and groups who, even in these trying times, try to lead men into the belief that there is no such thing as a "common interest" between management and men, and that as a consequence their only hope lies in independent organization, where they can try to help themselves through a policy of demanding their rights rather than through friendly consideration and co-operation with their co-workers.

Our nation stands today in a great emergency.

Having been bled white by the excruciating toll of a world wide depression, our National Administration has planned the most gigantic scheme of co-operation ever conceived.

The administrators of the National Industrial Recovery Act have themselves stated over and over again that their plans cannot succeed without the wholehearted co-operation of Industry, of Business of every kind, of Capital and of Labor. It is therefore evident that anything that tends to create misunderstanding, dissatisfaction with existing conditions, or to stir up conflict and dissension between groups who are and have been working happily together, is a crime against the Nation.

In the light of these facts it is difficult to understand why our national administration should directly or indirectly countenance or permit any such proceeding on the part of any individual or of any group, while it is of necessity demanding the full co-operation of every one.

Each community should, therefore, in its own interest call upon every loyal citizen to in every way possible discourage and discountenance the activities of any individual or of any group that attempts in any way to stir up the prejudices of men, to create dissension or to dampen or retard needed co-operation in any established business enterprise within its midst, during this national crisis.

As a matter of self preservation, if good will and real co-operation were ever needed in every community and within every business organization we need them now.

Every industrial and commercial enterprise, large and small, has fought for its very existence during the tragic days of the past three years, and if it had not withstood the storm its contribution to employment would have been gone. Employers generally have at the same time made every effort to keep the largest possible number of men and women at work, at a very great cost to their respective enterprises.

With improvement in demand only recently begun, after a period of tragic inactivity, with the economic progress of the world still to be assured, the whole Nation as well as Industry itself needs the benefit of the most co-operative effort at recovery that every individual and every institution can make.

It is certainly no time for any group of professional organizers to take advantage of the situation in an attempt to promote their selfish interests.

Code of Fair Competition of The Iron and Steel Industry*

ARTICLE I.
DEFINITIONS.

Wherever used in this Code or in any schedule appertaining hereto the terms hereinafter in this Article and in Schedule E annexed hereto defined shall, unless the context shall otherwise clearly indicate, have the respective meanings hereinafter in this Article and in such Schedule E set forth. The definition of any such term in the singular shall apply to the use of such term in the plural and vice versa.

Section 1.—The term "the United States" means and includes all of the territory of the United States of America on the North American continent.

Section 2.—The term "the President" means the President of the United States of America.

Section 3.—The term "products" means only pig iron, iron or steel ingots and the rolled or drawn iron or steel products which are generally named in Schedule F to the Code as at the time in effect and standard Tee rails of more than 60 pounds per yard, angle bars and rail joints, or any of such products.

Section 4.—The term "the industry" means and includes the business of producing in the United States and selling products, or any of them.

Section 5.—The term "member of the Industry" means and includes any person, firm, association or corporation operating a plant or plants in the United States for the production of products, or any of them.

Section 6.—The term "the Code" means and includes this Code and all schedules annexed hereto as originally approved by the President and all amendments hereof and thereof made as hereinafter in Article XII provided.

Section 7.—The term "member of the Code" means any member of the Industry who shall have become a member of the Code as hereinafter in Section 3 of Article III provided.

Section 8.—The term "the Institute" means American Iron and Steel Institute, a New York membership corporation.

Section 9.—The term "the Board of Directors" means the Board of Directors (as from time to time constituted) of the Institute.

Section 10.—The term "the Secretary" means the secretary of the Institute at the time in office.

*As approved by Executive Order of the President, Aug. 19, 1933.

Section 11.—The term "the Treasurer" means the treasurer of the Institute at the time in office.

Section 12.—The term "unfair practice" means and includes any act described as an unfair practice in Schedule H annexed hereto.

Section 13.—Wherever used in the Code with reference to the Industry or any member of the Industry or any member of the Code, unless the context shall otherwise clearly indicate.

(a) the term "plant" means only a plant for the production of one or more products in the Industry;

(b) the term "prices" includes only prices for products produced in the Industry;

(c) the term "wages" includes only wages for labor performed in the Industry;

(d) the term "labor" means only labor performed in the Industry;

(e) the term "hours of labor" or "hours of work" includes only hours of labor or hours of work in the Industry; and

(f) the term "employee" means only an employee in the Industry.

Section 14.—The term "the National Industrial Recovery Act" means the National Industrial Recovery Act as approved by the President June 16, 1933.

Section 15.—The term "the effective date of the Code" means the date on which the Code shall have been approved by the President pursuant to the National Industrial Recovery Act.

Section 16.—The term "the Administrator" means the Administrator appointed by the President under the National Industrial Recovery Act and at the time in office.

Section 17.—The term "the Administration" means the agency established pursuant to the provisions of Section 2 of the National Industrial Recovery Act.

ARTICLE II.

PURPOSE OF THE CODE.

Section 1.—The Code is adopted pursuant to Title I of the National Industrial Recovery Act.

Section 2.—The purpose of the Code is to effectuate the policy of Title I of the National Industrial Recovery Act in so far as it is applicable to the Industry.

ARTICLE III.

MEMBERSHIP IN THE CODE.

Section 1.—It is of the essence of the Code that all members of the Industry which shall comply with the provisions of the Code shall be entitled to participate in its benefits upon the terms and conditions set forth in the Code.

Section 2.—Any member of the Industry is eligible for membership in the Code.

Section 3.—Any member of the Industry desiring to become a member of the Code may do so by signing and delivering to the Secretary a letter substantially in the form set forth in Schedule A annexed hereto.

Section 4.—The rules and regulations in respect of meetings of members of the Code are set forth in Schedule B annexed hereto.

ARTICLE IV.

HOURS OF LABOR, RATES OF PAY AND OTHER CONDITIONS OF EMPLOYMENT.

Section 1.—Pursuant to subsection (a) of Section 7 of the National Industrial Recovery Act and so long as the Code shall be in effect, the Code shall be subject to the following conditions:

(1) That employees shall have the right to organize and bargain collectively through representatives of their own choosing, and shall be free from the interference, restraint, or coercion of employers of labor, or their agents, in the designation of such representatives or in self-organization or in other concerted activities for the purpose of collective bargaining or other mutual aid or protection;

(2) that no employee and no one seeking employment shall be required as a condition of employment to join any company union or to refrain from joining, organizing, or assisting a labor organization of his own choosing; and

(3) that employers shall comply with the maximum hours of labor, minimum rates of pay, and other conditions of employment, approved or prescribed by the President.

Section 2.—Since the beginning of the present depression and the consequent reduction in the total number of hours of work available in the Industry, its members have made every effort to distribute, and with a remarkable degree of success have distributed, the hours of work available in their plants so as to give employment to the maximum number of employees. It is the intention of the Industry to continue that policy in so far as practicable, to the end that the policy of Title I of the National Industrial Recovery Act may be effectuated, and that work in the Industry shall in so far as practicable be distributed so as to provide employment for the employees normally attached to the Industry. The basic processes in the Industry are of a continuous character and they cannot be changed in this respect without serious adverse effect upon production and employment. As demand for the products of the Industry and, therefore, for labor shall increase, hours of labor for employees in the Industry must necessarily increase; but, except in the case of executives, those employed in supervisory capacities and in technical work and their respective staffs and those employed in emergency work, in so far as practicable and so long as employees qualified for the work required shall be available in the respective localities where such work shall be required and having due regard for the varying demands of the consuming and processing industries for the respective products, none of the members of the Code shall cause or permit any employee to work at an average of more than 40 hours per week in any six months period or to work more than 48 hours or more than 6 days in any one week. On or after November 1, 1933, as soon as the members of the Code shall be operating at 60% of capacity, they shall adjust the operations of their plants so that, except as to executives, those employed in supervisory capacities and in technical work and their respective staffs and those employed in emergency work, they will establish the 8-hour

day for all their employees. For the purposes of this Section 2 the first six months period for each employee in the employ of any member of the Code at the effective date thereof shall begin with that date, and the first six months period for any employee thereafter employed by any member of the Code shall begin with the date of employment of such employee by such member. After the date of the employment by any member of the Code of any employee such member shall not knowingly permit such employee who also shall have performed work for one or more other employers to work for such member such number of hours as would result in a violation of the Code had all such work been performed for such member,.

Section 3.—None of the members of the Code shall employ in or about its plants in the Industry any person under 16 years of age.

Section 4.—Throughout the history of the Industry geographical wage differentials have existed, due in the main to differences in living costs and general economic conditions and the ability adequately to man the industries in the respective localities. The establishments in the Industry in the different localities have been developed under such differences in wages and, after a survey of the matters bearing on such differences in the various sections of the United States, for the purposes of this Article IV the wage districts described in Schedule C annexed hereto have been established.

Section 5:—Until changed by amendment of the Code as hereinafter in Article XII provided, the minimum rates of pay per hour which shall be paid by members of the Code for common labor (not including that of apprentices and learners) in the Industry in the respective wage districts described in such Schedule C shall be the rates set forth in Schedule D annexed hereto. None of the members of the Code shall pay common laborers (not including apprentices and learners) in its employ in the Industry in any such district any rate of pay less than the rate specified for such district in such Schedule D, and any violation of this provision of the Code shall be deemed an unfair practice. Such rates of pay shall not, however, be understood to be the maximum rates of pay for their respective districts, but, until changed as aforesaid, none of the members of the Code shall be required to pay its common laborers in the Industry in any of such districts a rate of pay higher than the rate specified for such district in such Schedule D, except as such member shall have agreed to pay such higher rate in any agreement heretofore or hereafter made by such member with its employees. Until this provision shall have been changed by amendment as aforesaid, each member of the Code will pay to each of its employees in the Industry who on July 14, 1933, was receiving pay at a rate of pay per hour in excess of the rate of pay per hour then being paid by such member for common labor a rate of pay per hour which shall be at least 15% greater than that which such employee was then receiving; provided, however, that the foregoing provision shall not be so construed as to require any member of the Code to make any increase in the rate of pay per hour to be paid by such member to any of its employees in any wage district that will result in a rate of pay per hour which shall be higher than the rate of pay per hour paid to employees doing substantially the same class or kind of labor in the same wage district by any other member of the Code which shall have increased its rates of pay per hour in accordance with such provision. In the case of employees (not including apprentices and learners) performing work for which they are paid per piece of work performed, the minimum rate of pay which each member of the Code shall pay for such work shall be sufficient to produce at the average rate of performance of such work at the time prevailing at the plant of such member where such work is performed the minimum rate of pay per hour provided in the Code for common labor at such plant.

ARTICLE V.

PRODUCTION AND NEW CAPACITY.

Section 1.—It is the consensus of opinion in the Industry that it is not necessary, in order to effectuate the policy of Title I of the National Industrial Recovery Act, to make any specific provision in the Code for controlling or regulating the volume of production in the Industry or for allocating production or sales among its members. It is believed that the elimination of unfair practices in the Industry will automatically eliminate any overproduction therein and any alleged inequities in the distribution of production and sales among its members. Adequate provision shall be made under the Code for the collection of statistics regarding production and of other data from which it may be determined from time to time whether overproduction in the Industry exists and whether in the circumstances any restriction of production is necessary in order to effectuate the policy of such Title I. The Board of Directors shall furnish to the Administrator summaries or compilations of such statistics and other data in reasonable detail. Should it at any time in the circumstances as they shall then exist appear to the Board of Directors that the policy of such Title I will not be effectuated in the Industry because of the fact that through the Code production therein is not controlled and regulated, then the Board of Directors is hereby empowered, subject to the approval of the President after such conference with or hearing of interested persons as he may prescribe, to make, modify or rescind such rules and regulations for the purpose of controlling and regulating production in the Industry, including the fixing of such liquidated damages for violations of such rules and regulations, as such Board shall deem to be necessary or proper in order to effectuate the policy of such Title I. All such rules and regulations from time to time so made and in effect shall be binding upon each member of the Code to which notice thereof shall have been given.

Section 2.—It is also the consensus of opinion in the Industry that, until such time as the demand for its products cannot adequately be met by the fullest possible use of existing capacities for producing pig iron and steel ingots, such capacities should not be increased. Accordingly, unless and until the Code shall have been amended as hereinafter provided so as to permit it, none of the members of the Code shall initiate the construction of any new blast furnace or open hearth or Bessemer

steel capacity. The President may, however, suspend the operation of the provisions of this Section.

ARTICLE VI.

ADMINISTRATION OF THE CODE.

Section 1.—The administration of the Code shall be under the direction of the Board of Directors. The Board of Directors shall have all the powers and duties conferred upon it by the Code and generally all such other powers and duties as shall be necessary or proper to enable it fully to administer the Code and to effectuate its purpose.

Section 2.—The Secretary shall act as Secretary under the Code. Under the direction of the Board of Directors, he shall keep all books (except books of account) and records under the Code and, except as such Board shall otherwise provide, shall collect, file and collate all statistics and other information required by the Board of Directors for the proper administration of the Code.

Section 3.—The Treasurer shall act as Treasurer under the Code and, under the direction of the Board of Directors, he shall have custody of and have charge of the disposition of, all funds collected under the Code; and he shall keep proper books of account showing the collection and disposition thereof.

Section 4.—The Board of Directors shall have power from time to time (a) to appoint and remove, and to fix the compensation of, all such other officers and employees and all such accountants, attorneys and experts, as said Board shall deem necessary or proper for the purpose of administering the Code and (b) to fix the compensation of the Secretary and the Treasurer for their services in acting under the Code.

Section 5.—The expenses of administering the Code shall be borne by the members thereof. The Board of Directors may from time to time make such assessments on account of such expenses against the members of the Code as it shall deem proper and such assessments shall be payable as such Board shall specify. The part of such expenses which shall be assessed against each member of the Code shall bear the same relation to the total thereof as the number of votes which, pursuant to the provisions of the Code, such member might cast at a meeting of the members thereof held at the time of any such assessment shall bear to the total number of votes that might be cast thereat by all the then members of the Code. Failure of any member of the Code to pay the amount of any assessment against such member for a period of thirty days after the date on which it became payable shall constitute a violation of the Code.

Section 6.—The Board of Directors may from time to time appoint such committees as it shall deem necessary or proper in order to effectuate the purpose of the Code, and it may delegate to any such committee generally or in particular instances such of the powers and duties of the Board of Directors under the Code as such Board shall deem necessary or proper in order to effectuate such purpose. Any member of any such committee may be a member of the Board of Directors or an officer or a director of a member of the Code or a person not having any official connection with any member of the Code or with the Institute, as the Board of Directors shall deem proper.

Section 7.—The members of the Code recognize that questions of public interest are or may be involved in its administration. Accordingly, representatives of the Administration consisting of the Administrator and one or two other persons appointed by him (who shall be persons not having or representing interests antagonistic to the interests of members of the Industry) shall be given full opportunity at such times as shall be reasonably convenient to discuss with the Board of Directors or any committees thereof any matters relating to the administration of the Code and to attend meetings of the Board at which action on any such matters shall be undertaken and to make recommendations as to methods or measures of administering the Code. Due notice of all such meetings of the Board of Directors shall be given to such representatives of the Administration. The records of the Board of Directors relating in any way to the administration of the Code shall be open to such representatives at all reasonable times. They shall be afforded by the Board of Directors complete access at all times to all records, statistical material or other information furnished or readily available to the Board of Directors in connection with, or for the purposes of, the administration of the Code. The Board of Directors, acting directly or through one or more committees appointed by it, shall give due consideration to all requests, suggestions or recommendations made by such representatives of the Administration and render every possible assistance to such representatives in obtaining full information concerning the operation and administration of the Code, to the end that the President may be fully advised regarding such operation and administration through reports that may be made to him from time to time by such representatives, and to the end that the President may be assured that the Code and the administration thereof do not promote or permit monopolies or monopolistic practices, or eliminate or oppress small enterprises, or operate to discriminate against them and do provide adequate protection of consumers, competitors, employees and others concerned and that they are in furtherance of the public interest and operate to effectuate the purposes of Title I of the National Industrial Recovery Act.

ARTICLE VII.

PRICES AND TERMS OF PAYMENT.

None of the members of the Code shall make any sale of any product at a price or on terms and conditions more favorable to the purchaser thereof than the price, terms or conditions established by such member in accordance with the provisions of Schedule E annexed hereto and in effect at the time of such sale; nor, except as otherwise provided in such Schedule E, shall any member of the Code make any contract of sale of any product at a price or on terms and conditions more favorable to the purchaser thereof than the price, terms and conditions established as aforesaid and in effect at the time of the making of such contract of sale.

ARTICLE VIII.

UNFAIR PRACTICES.

For all purposes of the Code the acts described in Schedule H annexed hereto shall constitute unfair practices. Such unfair practices and all other practices which shall be declared to be unfair practices by the Board of Directors as provided in paragraph M of such Schedule H or by any amendment to the Code adopted as hereinafter in Article XII provided and at the time in effect shall be deemed to be unfair methods of competition in commerce within the meaning of the Federal Trade Commission Act as amended, and the using or employing of any of them shall be deemed to be a violation of the Code, and any member of the Industry which shall directly, or indirectly through any officer, employee, agent or representative, knowingly use or employ any of such unfair practices shall be guilty of a violation of the Code.

ARTICLE IX.

REPORTS AND STATISTICS.

Section 1.—The Board of Directors shall have power from time to time to require each member of the Code to furnish to the Secretary for the use of the Board of Directors such information concerning the production, shipments, sales and unfilled orders of such member and the hours of labor, rates of pay and other conditions of employment at the plant or plants of such member and such other information as the Board of Directors shall deem necessary or proper in order to effectuate the purpose of the Code and the policy of Title I of the National Industrial Recovery Act. The Board of Directors may require that any such information be furnished periodically at such times as it shall specify and may require that any or all information furnished be sworn to or otherwise certified or authenticated as it shall prescribe. Failure of any member of the Code promptly to furnish to the Secretary information required by the Board of Directors and substantially in the form prescribed by it shall constitute a violation of the Code. The Board of Directors shall not require any information regarding trade secrets or the names of the customers of any member of the Code.

Section 2.—Any or all information furnished to the Secretary by any member of the Code shall be subject to checking for the purpose of verification by an examination of the books and accounts and records of such member by any accountant or accountants or other person or persons designated by the Board of Directors and shall be so checked for such purpose, if the Board of Directors shall require it. The cost of each such examination shall be treated as an expense of administering the Code; provided, however, that, if upon such examination any such information shall be shown to have been incorrect in any material respect, such cost shall be paid by the member of the Code which furnished such information.

Section 3.—The Board of Directors shall require the members of the Code from time to time to furnish such information as shall be necessary for the proper administration of the Code.

Section 4.—To the extent that the Board of Directors may deem that any information furnished to the Secretary in accordance with the provisions of the Code is of a confidential character in the interest of the member of the Code which shall have furnished it and that the publication thereof is not essential in order to effectuate the policy of Title I of the National Industrial Recovery Act, such information shall be treated by the Board of Directors and by the other members of the Code, if any knowledge of it shall have come to them, as strictly confidential; and no publication thereof to anyone or in any manner shall be made other than in combination with similar information furnished by other members of the Code, in which case the publication shall be made only in such manner as will avoid the disclosing separately of such confidential information.

Section 5.—Summaries or compilations in reasonable detail of all information which shall be furnished to the Secretary pursuant to the provisions of this Article IX shall be made periodically and sent to the Administrator.

ARTICLE X.

PENALTIES AND DAMAGES.

Section 1.—Any violation of any provision of the Code by any member of the Industry shall constitute a violation of the Code by such member.

Section 2.—Recognizing that the violation by any member of the Code of any provision of Article VII or of Schedule E of the Code will disrupt the normal course of fair competition in the Industry and cause serious damage to other members of the Code and that it will be impossible fairly to assess the amount of such damage to any member of the Code, it is hereby agreed by and among all members of the Code that each member of the Code which shall violate any such provision shall pay to the Treasurer as an individual and not as treasurer of the Institute, in trust, as and for liquidated damages the sum of $10 per ton of any products sold by such member in violation of any such provision.

Section 3.—Except in cases for which liquidated damages are fixed in the Code and in cases which shall give rise to actions in tort in favor of one or more members of the Code for damages suffered by it or them, the Board of Directors shall have power from time to time to establish the amount of liquidated damages payable by any member of the Code upon the commission by such member of any act constituting an unfair practice under the Code and a list of the amounts so fixed shall from time to time be filed with the Secretary. Upon the commission by any member of the Code of any act constituting an unfair practice under the Code and for which liquidated damages are not fixed in the Code or which does not give rise to an action in tort in favor of one or more members of the Code for damages suffered by it or them, such member shall become liable to pay to the Treasurer as an individual and not as treasurer of the Institute, in trust, liquidated damages in the amount at the time established by the Board of Directors for such unfair practice and specified in the list then on file with the Secretary as aforesaid.

Section 4.—All amounts so paid to or collected

by the Treasurer under this Article X or under Section 4 of Schedule E of the Code shall be held and disposed of by him as part of the funds collected under the Code and each member of the Code not guilty of the unfair practice in respect of which any such amount shall have been paid or collected shall be credited with its pro rata share of such amount on account of any and all assessments (other than damages for violation of any provision of the Code) due or to become due from such member under the Code, or, in the case of any excess, as shall be determined by the Board of Directors, such pro rata share to be computed on the same basis as the last previous assessment made against such member on account of the expenses of administering the Code as hereinbefore in Section 5 of Article VI provided. All rights of any person who shall at any time be the Treasurer in respect of any amounts which shall be payable to him because of the commission by any member of the Code of any act constituting an unfair practice under the Code, whether payable under the provisions of this Article X or under any other provision of the Code, shall pass to and become vested in his successor in office upon the appointment of such successor.

Section 5.—Each member of the Code by becoming such member agrees with every other member thereof that the Code constitutes a valid and binding contract by and among all members of the Code, subject, however, to the provisions of Section 6 of Article XI, and that, in addition to all penalties and liabilities imposed by statute, any violation of any provision of the Code by any member thereof shall constitute a breach of such contract and shall subject the member guilty of such violation to liability for liquidated damages pursuant to the provisions of the Code. Each member of the Code by becoming such member thereby assigns, transfers and delivers to the Treasurer as an individual and not as treasurer of the Institute, in trust, all rights and causes of action whatsoever which shall thereafter accrue to such member under the Code for such liquidated damages by reason of any violation of the Code by any other member thereof, and thereby designates and appoints, the Treasurer as such individual the true and lawful attorney-in-fact of such member to demand, sue for, collect and receipt for any and all amounts which shall be owing to such member in respect of any such right or cause of action, and to compromise, settle, satisfy and discharge any such right or cause of action, all in the name of such member or in the name of the Treasurer individually, as he shall elect.

Section 6.—Anything in the Code to the contrary notwithstanding, the Board of Directors by the affirmative vote of two-thirds of the whole Board may waive any liability for liquidated damages imposed by or pursuant to any provision of the Code for any violation of any provision thereof, if in its discretion it shall decide that such violation was innocently made and that the collection of such damages will not to any material extent tend to effectuate the policy of Title I of the National Industrial Recovery Act.

ARTICLE XI.

GENERAL PROVISIONS.

Section 1.—Any notice, demand or request required or permitted to be given to or made upon any member of the Code shall be sufficiently given if mailed postage prepaid addressed to such member at the address of such member on file with the Secretary. A waiver in writing signed by any member of the Code of any such notice, demand or request and delivered to the Secretary shall be deemed to be the equivalent of a notice, demand or request duly given or made, whether or not such waiver was signed and delivered before the time when such notice, demand or request was required or permitted to be given or made.

Section 2.—Nothing contained in the Code shall be deemed to constitute the members of the Code partners for any purpose. None of the members of the Code shall be liable in any manner to anyone for any act of any other member of the Code or for any act of the Board of Directors, the Treasurer or the Secretary, or any committee, officer or employee appointed under the Code. None of the members of the Board of Directors or of any committee appointed under the Code, nor the Treasurer, nor the Secretary, nor any officer or employee appointed under the Code, shall be liable to anyone for any action or omission to act under the Code, except for his wilful misfeasance or nonfeasance Nothing contained in the Code shall be deemed to confer upon anyone other than a member of the Code any right, claim or demand whatsoever not expressly provided by statute against any member of the Code or against any member of the Board of Directors or of any committee appointed under the Code or against the Treasurer or the Secretary or any officer or employee appointed under the Code.

Section 3.—As soon as members of the Industry which would, if then members of the Code, have the right to cast at least 75% of all the votes that might be cast at a meeting of the members of the Code, if all members of the Industry were then members of the Code and present at such meeting, shall sign and deliver to the Secretary letters substantially in the form set forth in Schedule A annexed hereto, the Board of Directors shall submit the Code to the President pursuant to the provisions of Title I of the National Industrial Recovery Act and, upon the approval of the Code by the President pursuant to the provisions of such Title I, it shall constitute a binding contract by and among the members of the Code and the provisions thereof shall be the standards of fair competition for the Industry; subject, however, to amendment or termination as hereinafter in Article XII provided, and subject also to the provisions of Section 6 of this Article XI.

Section 4.—To the extent required or made possible by or under the provisions of Title I of the National Industrial Recovery Act the provisions of the Code shall apply to and be binding upon every member of the Industry, whether or not such member shall be a member of the Code. No member of the Industry which shall not also be a member of the Code shall be entitled to vote at any meeting of members of the Code or to any other right, power or privilege provided in the Code for the members thereof.

Section 5.—The Board of Directors shall have power from time to time to interpret and construe the provisions of the Code, including, but without any limitation upon the foregoing, the power to

determine what are products within the meaning of that term as it is used in the Code. Any interpretation or construction placed upon the Code by the Board of Directors shall be final and conclusive upon all members of the Code.

Section 6.—The members of the Code recognize that, pursuant to subsection (b) of Section 10 of the National Industrial Recovery Act, the President may from time to time cancel or modify any order, approval, license, rule or regulation issued under Title I of said Act.

ARTICLE XII.

AMENDMENTS—TERMINATION.

Section 1.—The Code may be amended at any time in the manner in this Section 1 provided. The changing of any schedule hereto or the addition hereto of any new schedule shall constitute an amendment of the Code. All amendments shall be proposed by the Board of Directors by vote of the majority of the members thereof at the time in office. Each amendment so proposed shall be submitted to a meeting of the members of the Code which shall be called for such purpose upon notice given in accordance with the provisions of Section 1 of Schedule B and Section 1 of Article XI of the Code. If at such meeting members of the Code having the right to cast at least 75% of all the votes that might be cast at such meeting, if all the members of the Code were present thereat, shall vote in favor of the adoption of such amendment, such amendment shall be submitted by the Board of Directors to the President for approval, if approval thereof by him shall then be required by law. Every such amendment shall take effect as a part of the Code upon the adoption thereof by the members of the Code as above provided and the approval thereof by the President, if approval thereof by him shall be required as aforesaid.

Section 2.—The Code shall continue in effect for a period of ninety (90) days after the effective date thereof, in order to afford to the President an opportunity to determine upon the recommendations of the representatives of the Administration, for which provision has heretofore been made in Article VI, whether its provisions will effectuate the purposes of Title I of the National Industrial Recovery Act, as further defined in said Article VI, subject, however, to amendment at any time as hereinbefore provided, and also subject to the reserved power of the President to cancel or modify his approval thereof. The Code shall continue in effect after the expiration of said period of ninety (90) days in the absence of the exercise of such reserved power on the part of the President, or in the absence of the exercise by members of the Code of the power which they hereby reserve to terminate the Code at any time after the expiration of said period of ninety (90) days by the same action by them as is above provided for the amendment thereof. When so terminated all obligations and liabilities under the Code shall cease, except those for unpaid assessments theretofore made in accordance with the provisions of the Code and those for liquidated damages theretofore accrued under any provision of the Code.

August 17, 1933.

SCHEDULE A.

FORM OF LETTER OF ASSENT TO THE CODE.

, 19 .

To the Secretary of
American Iron and Steel Institute,
Empire State Building,
New York, N. Y.

Dear Sir:

The undersigned, desiring to become a member of the Code of Fair Competition of the Iron and Steel Industry, a copy of which is annexed hereto marked Annex A, hereby assents to all of the provisions of said Code (hereinafter referred to as the Code), and, effective as of the date on which the Code shall have been approved by the President of the United States of America as therein provided, or as of the date on which this letter shall have been delivered, if delivery thereof shall have been made subsequent to the date on which the Code shall have been approved by said President as aforesaid, by the signing and delivery of this letter becomes a member of the Code and effective as aforesaid hereby agrees with every person, firm, association and corporation who shall then be or thereafter become a member of the Code that the Code shall constitute a valid and binding contract between the undersigned and all such other members.

Effective as aforesaid, pursuant to Section 5 of Article X of said Code, the undersigned (a) hereby assigns, transfers and delivers to the Treasurer under the Code, as an individual and not as treasurer of American Iron and Steel Institute, in trust, all rights and causes of action whatsoever hereafter accruing to the undersigned under the Code for liquidated damages by reason of any violation thereof by anyone, and (b) hereby designates and appoints said Treasurer as such individual the true and lawful attorney-in-fact of the undersigned, to demand, sue for, collect and receipt for any and all amounts which shall be owing to the undersigned in respect of any such right or cause of action, and to compromise, settle, satisfy and discharge any such right or cause of action, all in the name of the undersigned or in the name of said Treasurer, as said Treasurer shall elect.

For all purposes of Section 1 of Article XI of the Code the address of the undersigned, until it shall file with the Secretary of American Iron and Steel Institute written notice of a change of such address, shall be as set forth at the foot of this letter.

Very truly yours,

Address:

SCHEDULE B.

THE RULES AND REGULATIONS IN RESPECT OF MEETINGS OF MEMBERS OF THE CODE.

Section 1.—A meeting of members of the Code may be called and held at any time by order of the Board of Directors, or by members of the Code having the right to cast at least 50% of all the votes that might be cast at such meeting, if all the members of the Code were present thereat, on not less than three days' notice to each of such members

stating the time and place of such meeting and the purposes thereof.

Section 2.—At each meeting of the members of the Code each member thereof shall have as many votes as shall equal the quotient obtained by dividing by 500,000 the aggregate amount in dollars of the invoiced value of the products delivered by such member for consumption within the United States during the preceding calendar year. Fractions in such quotient shall be disregarded; provided, however, that each member of the Code shall have at least one vote. All questions as to the number of votes which each member of the Code shall be entitled to cast at any meeting of the members thereof shall be determined by the Board of Directors. Any person or firm who shall be a member of the Code may, and any association or corporation which shall be a member of the Code shall, vote at meetings of the members of the Code by proxy in writing duly executed by such member and filed with the Secretary. Any such proxy may be for a specified meeting or be a general proxy for any or all meetings that may be held until such proxy shall have been revoked by an instrument in writing duly executed by the member of the Code which gave such proxy and filed with the Secretary.

Section 3.—At each meeting of the members of the Code, members thereof having the right to cast at least 75% of all the votes that might be cast at such meeting, if all the members of the Code were present thereat, shall constitute a quorum for the transaction of business at such meeting.

SCHEDULE C.

DESCRIPTION OF WAGE DISTRICTS.

1—EASTERN DISTRICT:
Comprises that part of the United States which is north of the State of Virginia and east of a line drawn north and south through the most easterly point of Altoona, Pennsylvania; that part of the State of Maryland which is west of such line; and the Counties of Monongalia, Marion and Harrison in the State of West Virginia.

2—JOHNSTOWN DISTRICT:
Comprises Cambria County and the City of Altoona in the State of Pennsylvania.

3—PITTSBURGH DISTRICT:
Comprises the Counties of Westmoreland, Fayette, Greene, Washington, Allegheny, Beaver, Butler, Armstrong and Jefferson and that part of the County of Clearfield which is west of a line drawn north and south through the most easterly point of Altoona, all in the State of Pennsylvania.

4—YOUNGSTOWN VALLEY DISTRICT:
Comprises the Counties of Lawrence, Mercer and Venango in the State of Pennsylvania and the Counties of Trumbull, Mahoning and Columbiana in the State of Ohio.

5—NORTH OHIO RIVER DISTRICT:
Comprises the cities along the Ohio River north of the City of Parkersburg, West Virginia, and the Counties of Belmont and Jefferson in the State of Ohio and the Counties of Marshall, Ohio, Brook and Hancock in the State of West Virginia.

6—CANTON, MASSILLON AND MANSFIELD DISTRICT:
Comprises the Counties of Stark, Tuscarawas, Summit and Richland in the State of Ohio.

7—CLEVELAND DISTRICT:
Comprises the Counties of Ashtabula, Lake, Cuyahoga and Lorain in the State of Ohio.

8—BUFFALO DISTRICT:
Comprises that part of the State of New York west of a line drawn north and south through the most easterly point of Altoona, Pennsylvania, and Erie County in that State.

9—DETROIT-TOLEDO DISTRICT:
Comprises the Counties of Seneca and Lucas in the State of Ohio and the Counties of Monroe, Lenawee, Jackson, Wayne, Oakland, Macomb and Washtenaw in the State of Michigan.

10—SOUTH OHIO RIVER DISTRICT:
Comprises the State of Kentucky, the City of Parkersburg, West Virginia, the cities along the Ohio River south of said City, the Counties of Guernsey, Muskingum, Jackson and Butler in the State of Ohio and the County of Wood in the State of West Virginia.

11—INDIANA-ILLINOIS-ST. LOUIS DISTRICT:
Comprises all the State of Indiana, except the County of Lake; all the State of Illinois, except the Counties of Lake and Du Page and the Chicago Switching District; the City of St. Louis and the County of St. Louis in the State of Missouri; and the County of Rock in the State of Wisconsin.

12—CHICAGO DISTRICT:
Comprises the Chicago Switching District; the Counties of Lake and Du Page in the State of Illinois; the County of Lake in the State of Indiana; and the Counties of Kenosha, Racine and Milwaukee in the State of Wisconsin.

13—SOUTHERN DISTRICT:
Comprises all that part of the United States south of the States of Maryland, West Virginia, Kentucky and Missouri, and the States of Texas and Oklahoma, but does not include the County of Jefferson in the State of Alabama.

14—BIRMINGHAM DISTRICT:
Comprises the County of Jefferson in the State of Alabama.

15—KANSAS CITY DISTRICT:
Comprises the County of Jackson in the State of Missouri.

16—DULUTH DISTRICT:
Comprises the County of St. Louis in the State of Minnesota.

17—COLORADO DISTRICT:
Comprises the State of Colorado.

18—UTAH DISTRICT:
Comprises the State of Utah.

19—SEATTLE DISTRICT:
Comprises the County of King in the State of Washington and the County of Multonomah in the State of Oregon.

20—SAN FRANCISCO DISTRICT:
Comprises the Counties of San Mateo, Alameda, Sacramento and Contra Costa in the State of California.

21—LOS ANGELES DISTRICT:
Comprises the County of Los Angeles in the State of California.

SCHEDULE D.

MINIMUM RATES OF PAY FOR COMMON LABOR.

	Cents per hr.
1—Eastern District	35
2—Johnstown District	37
3—Pittsburgh District	40
4—Youngstown Valley District	40
5—North Ohio River District	40
6—Canton, Massillon and Mansfield District	37
7—Cleveland District	40
8—Buffalo District	38
9—Detroit-Toledo District	40
10—South Ohio River District	37
11—Indiana-Illinois-St. Louis District	37
12—Chicago District	40
13—Southern District	25
14—Birmingham District	27
15—Kansas City District	35
16—Duluth District	37
17—Colorado District	40
18—Utah District	39
19—Seattle District	38
20—San Francisco District	37
21—Los Angeles District	35

SCHEDULE E.

CONCERNING PRICES AND TERMS OF PAYMENT.

Section 1.—Wherever used in the Code the terms hereinafter in this Section 1 defined shall, unless the context shall otherwise clearly indicate, have the respective meanings hereinafter in this Section 1 set forth. The definition of any such term in the singular shall apply to the use of such term in the plural and vice versa.

(a) Until Schedule F of the Code shall have been amended as in Article XII of the Code provided, the term "basing point" for any product means one of the places listed in such Schedule F as a basing point for such product. Thereafter the term shall mean one of the places listed in such Schedule F as at the time in effect as a basing point for such product.

(b) The term "base price" of any product means the price for such product f. o. b. a basing point, before any extras in respect of such product shall be added or any discounts for early payment or deductions shall be allowed or made.

(c) The term "period of free credit" means the period of time between the date of a shipment of a product to the purchaser of such product and the date from and after which such purchaser shall be required to pay interest on the purchase price of such product or any part thereof which shall not have been paid prior to the expiration of such period.

(d) The term "date of invoice" means the date of the invoice of any product.

(e) The term "discount for early payment" means the amount of the deduction allowed for the payment of an invoice of products before the expiration of the period of free credit in respect thereof.

(f) The term "an affiliated group" means one or more corporations connected through stock ownership with a common parent corporation, if (1) at least 75% of the stock of each of such corporations (except such common parent corporation) is owned directly by one or more of the other corporations, and (2) such common parent corporation owns directly at least 75% of the stock of at least one of the other corporations. The term "an affiliated company of a member of the Code" means (1) a corporation which is one of an affiliated group that also includes such member of the Code, or (2), in case the member of the Code is a person, firm or association, a corporation at least 75% of the stock of which is owned by such member. For the purposes of this paragraph (f) the term "stock" does not include non-voting stock which is limited and preferred as to dividends.

Section 2.—Each member of the Code shall, within ten days after the effective date of the Code, file with the Secretary a list showing the base prices for all its products, and from and after the expiration of such ten days such member shall at all times maintain on file with the Secretary a list showing the base prices for all its products and shall not make any change in such base prices except as provided in this Schedule E. Each such list shall state the date upon which it shall become effective, which date shall be not less than ten days after the date of filing such list with the Secretary; provided, however, that the first list of base prices filed by any member of the Code as above provided shall take effect on the date of filing thereof. None of the base prices shown in any list filed by any member of the Code as herein provided shall be changed except by the filing by such member with the Secretary of a new list of its base prices, which shall become effective on the effective date therein specified which shall not be less than ten days after the date on which such new price list shall have been so filed. In the case of pipe of sizes or kinds which are sold on a list and discount basis, for the purposes of this Section 2 the list of base prices shall consist of a price list and one or more basing discount lists, from which the base prices of such pipe shall be determined; provided, however, that in the case of oil country tubular goods there shall be filed in lieu of a list of base prices a price list and one or more basing discount lists from which the delivered prices of such goods shall be determined.

Section 3.—Except as hereinafter otherwise provided in respect of standard Tee rails of more than 60 pounds per yard, angle bars and rail joints, the

base price for any product shown in any list of base prices filed by a member of the Code in accordance with the provisions of the foregoing Section 2 shall be as follows: (a) If such member shall operate a plant for the production of such product which is located at a basing point for such product, f. o. b. such basing point, or (b), if such member shall operate a plant for the production of such product which is not located at a basing point for such product, f. o. b. the basing point for such product nearest in terms of all-rail freight rates to such plant, or (c), if any Gulf or Pacific Coast port shall be listed as a basing point in Schedule F of the Code as at the time in effect, f. o. b. cars dock such port. Except as otherwise provided in this Schedule E, each member of the Code shall file with the Secretary and maintain on file with him a list showing the base price for each of its products for each basing point for such product at which a plant of such member for the manufacture of such product shall be located and for each basing point for such product which shall be nearest in terms of all-rail freight rates to any plant of such member for the manufacture of such product not located at a basing point for such product; and, if any Gulf or Pacific Coast port shall be listed in such Schedule F as a basing point for a product, such member may show in such list its base price for such product at such basing point. All base prices shown in the list so filed shall constitute the published base prices of such member for the products and for the basing points shown in such list. Except as aforesaid, none of the members of the Code shall file any list of base prices showing any price for any of its products other than the base price for such product f. o. b. the basing point or basing points for such product as hereinbefore provided. The published base price of each such member for any product (except standard Tee rails of more than 60 pounds per yard, angle bars and rail joints) for any basing point for such product other than that or those shown in the list of base prices so filed by such member shall be deemed to be the lowest base price for such product at such other basing point which shall be shown in the list of base prices filed by any other member of the Code and then in effect. All base prices for standard Tee rails of more than 60 pounds per yard and all base prices for angle bars and rail joints shall be f. o. b. mill of the producer thereof, or, in the case of rails, angle bars and rail joints carried by water from any Atlantic Coast or Gulf port to any Gulf or Pacific Coast port, c.i.f. the port of destination. Lists of prices filed with the Secretary pursuant to the foregoing Section 2 and to this Section 3 shall be open to inspection at all reasonable times by anyone.

Section 4.—Except as otherwise provided in this Schedule E of the Code, all prices quoted and billed by any member of the Code for any product (except standard Tee rails of more than 60 pounds per yard, angle bars and rail joints and oil country tubular goods, which shall be quoted and billed as hereinafter provided) sold by such member from and after ten days after the effective date of the Code shall be delivered prices, which (disregarding the extras, if any, required by, and the deductions, if any, that may be made pursuant to, the provisions of the Code) shall be not less than the sum of (a) the published base price of such member for such product effective at the time of the sale thereof and (b) the all-rail published tariff freight charges from the basing point on which such base price is based to the place of delivery to the purchaser thereof, or, (1) if such place of delivery shall be at such basing point, the published tariff switching charges to such place of delivery from the plant of any member of the Code for the production of such product at such basing point nearest in terms of such switching charges to such place of delivery; or, (2) if such place of delivery shall be at a Gulf or Pacific Coast port that is listed in Schedule F as a basing point, the published tariff switching charges to such place of delivery from the dock for discharging products nearest in terms of such switching charges to such place of delivery; provided, however, that (a) in any case in which such product shall be delivered by other than all-rail transportation, the member of the Code selling such product may allow to the purchaser a reduction in the delivered price otherwise chargeable under this Section 4 at a rate which shall have been previously approved by the Board of Directors and filed with the Secretary; and (b) in the case of plates, shapes or bars intended for fabrication for an identified structure, for the purpose of establishing the delivered price thereof, the place of delivery shall be deemed to be the freight station at or nearest to the place at which such structure is to be erected, and not the shop of the fabricator; and (c) subject as hereinafter in this Section 4 provided, if any list of prices filed with the Secretary by any member of the Code pursuant to this Schedule E and at the time in effect shall show a specified rate of deduction from the price of any product to be allowed by such member on any sale of such product to any jobber for resale, such member may, from and after the date on which such list shall have become effective, allow to any jobber to whom such member shall sell such product for resale a deduction from such price to such jobber for such product at a rate not greater than the rate so shown in such list; and provided, further, that the Board of Directors by the affirmative vote of three-fourths of the whole Board may permit any member of the Code in special instances or members of the Code generally to sell or contract for the sale of any product produced by such member or members at a base price which shall be less than the then published base price of such member or members for such product at the respective basing points therefor of such members, if by such vote such Board shall determine that the making of such sale or contract of sale at such less base price is in the interest of the Industry or of any other branch of industry and will not tend to defeat the policy of Title I of the National Industrial Recovery Act by making possible the using or employing of an unfair practice. The Board of Directors shall prescribe such rules and regulations as it shall deem proper by which the question of whether or not any purchaser or prospective purchaser of any product for resale is a jobber shall be determined, and in granting any permission as aforesaid, the Board of Directors shall prescribe such rules and regulations in respect thereof as in its judgment shall be necessary in order to insure to the members of the Code that action in accordance with any such permission shall

not result in an unfair practice; and thereafter such Board may by like vote rescind any permission so granted or modify, cancel or add to any rules and regulations so prescribed. The Secretary shall send to each member of the Code a copy of all such rules and regulations prescribed by such Board with respect to the determination of the question of whether a purchaser or prospective purchaser for resale is a jobber and he shall give notice in writing of all action so taken by the Board of Directors to each member of the Code which at the time shall be engaged in producing the kind of product in respect of which any such permission was granted. Before any member of the Code shall allow any such deduction to any jobber or sell for resale to any purchaser who shall not be a jobber any product pursuant to any permission so granted to such member, such member shall secure from such jobber or such other purchaser an agreement substantially in a form theretofore approved by the Board of Directors and filed with the Secretary whereby such jobber or other purchaser shall agree with such member (a) that such jobber or other purchaser will not, without the approval of the Board of Directors, sell such product to any third party at a price which at the time of the sale thereof shall be less than the price at which such member might at that time sell such product to such third party, and (b) that, if such jobber or such other purchaser shall violate any such agreement, he shall pay to the Treasurer as an individual and not as treasurer of the Institute, in trust, as and for liquidated damages the sum of $10 per ton of any product sold by such jobber or such other purchaser in violation thereof. Except as aforesaid, all prices quoted and billed by any member of the Code for standard Tee rails of more than 60 pounds per yard, angle bars and rail joints sold by it from and after ten days after the effective date of the Code (disregarding extras and deductions as aforesaid) shall be not less than the published base price of such member for such rails, angle bars and rail joints effective at the time of the sale thereof f. o. b. mill of the producer, or, in the case of rails, angle bars or rail joints carried by water from any Atlantic Coast or Gulf port to any Gulf or Pacific Coast port, c.i.f. the port of destination. Except as aforesaid, all prices quoted and billed by any member of the Code for oil country tubular goods sold by it from and after ten days after the effective date of the Code (disregarding extras and deductions as aforesaid) shall be not less than the delivered price for such goods determined by deducting from the published list price of such member for such goods effective at the time of the sale thereof the published basing discounts applicable to such goods effective at such time. In case at the effective date of the Code any valid, firm contract to which a member of the Code shall be a party shall exist for a definite quantity of any product or for all or a substantial part of the requirements of the purchaser thereof (a) at a fixed price, or (b) at a price that can be definitely determined in accordance with the provisions of such contract, or (c) at the market price for such product at the date when a definite quantity thereof shall be specified under such contract and such contract covered a sale of 20% or more of the total quantity of such product produced and sold in the United States in the calendar year 1932, it is recognized that such contract will tend to establish the market price for such product during the remainder of its life and that, if the other members of the Code which produce and sell such product shall by the foregoing provisions of this Schedule E be prevented from selling such product during the remainder of the life of such contract at as favorable a price and on as favorable terms and conditions as those provided for in such contract, then unfair competition as between the member of the Code which shall be a party to such contract and the other members thereof and also as between the other party to such contract and its competitors may result. Accordingly, anything herein to the contrary notwithstanding, during the remainder of the life of such contract any member of the Code may sell such product at a price and on terms and conditions as favorable as (but not more favorable than) the price, terms and conditions provided for in such contract.

Section 5.—The Board of Directors shall have power on its own initiative, or on the complaint of any member of the Code, to investigate any base price for any product at any basing point shown in any list filed with the Secretary by any member of the Code, and for the purpose of the investigation thereof to require such member to furnish such information concerning the cost of manufacturing such product as the Board of Directors shall deem necessary or proper for such purpose. If the Board of Directors after such investigation shall determine that such base price is an unfair base price for such product at such basing point, having regard to the cost of manufacturing such product, and that the maintenance of such unfair base price may result in unfair competition in the Industry, the Board of Directors may require the member of the Code that filed the list in which such unfair base price is shown to file a new list showing a fair base price for such product at such basing point, which fair base price shall become effective immediately upon the filing of such list. If such member of the Code shall not within ten days after notice to it of such determination by the Board of Directors file a new list showing such fair base price for such product at such basing point, the Board of Directors shall have power to fix a fair base price for such product at such basing point, which fair base price, however, shall not be more than the base price of any other member of the Code at that time effective for such product at such basing point and in respect of which the Board of Directors shall not theretofore have begun an investigation or a complaint shall not have been made by any member of the Code. When the decision of such Board fixing such fair base price shall have been filed with the Secretary and the Secretary shall have given notice thereof to such member, such fair base price shall be the base price of such member for such product at such basing point, until it shall have been changed as in the Code provided. A notice of all decisions of the Board of Directors under this Section 5, together with the reasons therefor, shall be filed with the President.

Section 6.—The Board of Directors by the affirmative vote of a majority of the whole Board may establish maximum rates of discount and maximum periods of free credit, other than those specified in Schedule G of the Code, which may be allowed by

any member of the Code with respect to the sale of any product or products to jobbers for resale as permitted by the provisions of Section 4 of this Schedule E. The Secretary shall give notice in writing of any action taken by the Board of Directors in accordance with the provisions of this Section 6 to each member of the Code which at the time shall be engaged in producing the kind of product in the sale of which any such other rates or periods shall have been established by such action. Except as aforesaid and except as elsewhere in this Schedule E of the Code otherwise provided, the maximum rates of discount for early payment and the maximum periods of free credit which may be allowed by any member of the Code shall be the rates and periods specified in said Schedule G. Except as aforesaid, all invoices for products sold by any member of the Code after the effective date of the Code shall bear interest from and after the expiration of the period of free credit at a rate which shall be not less than the then current rate established by the Board of Directors and filed with the Secretary. Nothing in the Code contained shall prevent any member of the Code from allowing credit to any purchaser or allowing any purchaser to delay payment in respect of any invoice for a longer period than the maximum period of free credit specified in such Schedule G or such other maximum period as shall be established in accordance with the provisions of this Section 6; but, if any member of the Code shall allow credit to any purchaser or allow any purchaser to delay payment in respect of any invoice for a period longer than such maximum period of free credit, then such member shall charge and collect interest on the amount in respect of which credit shall be so allowed or the payment of which shall have been so delayed at a rate not less than the current rate established and filed as aforesaid.

Section 7.—Except as in this Schedule E of the Code otherwise provided, any extras added to, and any deductions made from, the base price for any product sold by any member of the Code in determining its quoted or billed price for such product shall be uniform for all members of the Code. The rates of such extras and of such deductions shall be those approved from time to time by the Board of Directors as being in accordance with the trade practice customary in the Industry at the effective date of the Code and as meeting the requirements of the Code. Lists showing such rates shall be filed with the Secretary and shall be open to inspection at all reasonable times by anyone. In case any member of the Code shall sell any product to which any such rate of extra or deduction shall apply, except as aforesaid such member shall add an extra at a rate which shall not be less than the rate of extra applicable to such product theretofore approved by the Board of Directors as aforesaid and at the time in effect and none of the members of the Code shall make any deduction at a rate that shall be more favorable to the purchaser of such product than the rate of deduction applicable to such product theretofore approved by the Board of Directors as aforesaid and at the time in effect; provided, however, that nothing in the Code contained shall be so construed as to prevent any member of the Code from selling or contracting to sell any product for use by the purchaser thereof in the manufacture of articles for shipment in export trade within the meaning of the term "export trade" as it is used in the Export Trade Act under an agreement by such member of the Code with such purchaser that, when such articles shall have been shipped in such export trade, such member of the Code shall make an allowance at a rate approved by the Board of Directors and a statement of the approval of which shall theretofore have been filed with the Secretary, which rate in the opinion of such Board shall be sufficient to enable such member of the Code or such purchaser to meet foreign competition in the sale and delivery of such product or such articles, as the case may be.

Section 8.—The practice of shipping products on consignment may result in unfair competition and it is the intention of the Industry to eliminate such practice as soon as possible after the effective date of the Code. Accordingly, except to the extent necessary to carry out arrangements existing on the effective date of the Code and which shall have been reported to the Board of Directors, from and after such date none of the members of the Code shall deliver products, other than pipe, on consignment except to an affiliated company of such member. All arrangements for the delivery by any member of the Code of products on consignment (other than consignments to an affiliated company of such member and other than consignments of pipe) existing on the effective date of the Code shall be terminated on or before June 30, 1934, and all stock held on consignment on that date shall either be sold to the consignee or possession thereof shall be taken by the consignor. The Board of Directors shall investigate problems presented in the elimination of consigned stocks of pipe and shall recommend to the members of the Code which shall be parties to then existing arrangements with respect to shipments of pipe on consignment (other than consignments from a member of the Code to an affiliated company) such action in respect thereof as such Board shall deem proper and designed to accomplish the termination of all such arrangements (other than as aforesaid) at as early a date as possible.

Section 9.—For all purposes of this Schedule E, a delivery of any product made pursuant to a contract of sale shall be regarded as a sale thereof made at the time of the making of such contract. Except in the case of a product required by a purchaser for a specified definite contract of such purchaser with a third party at a fixed price, none of the members of the Code shall make any contract of sale of any product by the terms of which the shipment of such product is not required to be completed before the end of the calendar quarter-year ending not more than four months after the date of the making of such contract.

Section 10.—Nothing in the Code contained, however, shall be so construed as to prevent the performance by any member of the Code of a valid, firm contract existing and to which it is a party at the effective date of the Code for a definite quantity of any product or for all or a substantial part of the requirements of the purchaser thereof (a) at a fixed price, or (b) at a price that can be definitely determined in accordance with the provisions of such contract, or (c) at the market price for such product at the date when a definite quantity thereof shall be specified under such contract. If any mem-

ber of the Code shall at the effective date thereof be a party to any contract for the sale of any product by such member which by its terms is to continue after December 31, 1933, and by its terms the price to be paid for such product by the other party to such contract is related to the market price thereof at the date when a definite quantity thereof may be specified under such contract and may be less than such market price, then such member shall within thirty days after the effective date of the Code file a copy of such contract with the Secretary in order that the Board of Directors may consider it and take such action in respect thereof consistent with the rights and obligations of the parties to such contract as such Board shall deem proper.

Section 11.—A sale made by any member of the Code indirectly through any affiliated company of such member shall be deemed to be a sale made by such member.

Section 12.—Nothing in the Code contained shall be deemed to apply to or affect the sale of any product for direct shipment in export trade by any member of the Code within the meaning of the term "export trade" as it is used in the Export Trade Act or, unless and to the extent that the Board of Directors shall otherwise determine, the sale of any product by any such member for direct shipment to the Philippines, Hawaii or Porto Rico or other insular possessions of the United States of America.

Section 13.—If and to the extent requested by the Administrator, all decisions of, permissions and approvals given by and rules and regulations made by, the Board of Directors pursuant to any provision of this Schedule E shall be reported to him.

SCHEDULE F.

LIST OF BASING POINTS:

The places hereinafter in this Schedule F listed are the basing points for the respective products named.

AXLES—ROLLED OR FORGED:

Pittsburgh, Pa.
Chicago, Ill.
Birmingham, Ala.

BALE TIES:

Pittsburgh, Pa.
Cleveland, O.
Chicago, Ill.
Birmingham, Ala.
Duluth, Minn.
Gulf Ports*
Pacific Coast Ports**

BARS—ALLOY STEEL, HOT ROLLED:

Pittsburgh, Pa.
Buffalo, N. Y.
Chicago, Ill.
Canton, O.
Massillon, O.
Bethlehem, Pa.

BARS—COLD FINISHED, CARBON AND ALLOY:

Pittsburgh, Pa.
Buffalo, N. Y.
Cleveland, O.
Chicago, Ill.
Gary, Ind.

BARS—CONCRETE REINFORCING:

Pittsburgh, Pa.
Buffalo, N. Y.
Cleveland, O.
Chicago, Ill.
Gary, Ind.
Birmingham, Ala.
Youngstown, O.
Gulf Ports
Pacific Coast Ports

BARS—IRON:

Pittsburgh, Pa.
Troy, N. Y.
Jersey City, N. J.
Dover, N. J.
Philadelphia, Pa.
Columbia, Pa.
Lebanon, Pa.
Reading, Pa.
Danville, Pa.
Burnham, Pa.
Creighton, Pa.
Richmond, Va.
Louisville, Ky.
Terre Haute, Ind.

BARS—MERCHANT STEEL:

Pittsburgh, Pa.
Buffalo, N. Y.
Cleveland, O.
Chicago, Ill.
Gary, Ind.
Birmingham, Ala.
Gulf Ports
Pacific Coast Ports

BARS—TOOL STEEL:

Pittsburgh, Pa.
Syracuse, N. Y.
Bethlehem, Pa.

GIRDER RAILS:

Lorain, O.
Steelton, Pa.

INGOTS, BLOOMS, BILLETS AND SLABS—ALLOY:

Pittsburgh, Pa.
Buffalo, N. Y.
Chicago, Ill.
Canton, O.
Massillon, O.
Bethlehem, Pa.

INGOTS, BLOOMS, BILLETS AND SLABS—CARBON:

Pittsburgh, Pa.
Buffalo, N. Y.
Cleveland, O.
Chicago, Ill.
Gary, Ind.
Birmingham, Ala.
Youngstown, O.

*Except as otherwise shown in this Schedule F, the Gulf Ports are Mobile, Ala.; New Orleans, La.; and Orange, Port Arthur, Beaumont, Baytown, Galveston and Houston, Tex.

**The Pacific Coast Ports are San Pedro (includes Wilmington) and San Francisco (includes Oakland), Cal.; Portland, Ore.; and Seattle (includes Tacoma), Wash.; and San Diego, Cal., for Plates and Structural Shapes only.

LIGHT RAILS—60 LBS. OR LESS PER YARD:
Pittsburgh, Pa.
Chicago, Ill.
Birmingham, Ala.

MECHANICAL TUBING:
Pittsburgh, Pa.
Canton, O.
Shelby, O.
Detroit, Mich.
Milwaukee, Wis.

PIG IRON—FOUNDRY, MALLEABLE, OPEN HEARTH BASIC, AND BESSEMER:
Buffalo, N. Y.
Cleveland, O.
Chicago, Ill.
Birmingham, Ala.
Youngstown, O.
Neville Is., Pa.
Sharpsville, Pa.
Erie, Pa.
Bethlehem, Pa.
Swedeland, Pa.
Birdsboro, Pa.
Hamilton, O.
Jackson, O.
Toledo, O.
Granite City, Ill.
Detroit, Mich.
Duluth, Minn. (except open hearth basic.)
Provo, Utah
Everett, Mass.
Sparrows Point, Md.

PIG IRON—LOW PHOSPHOROUS:
Birdsboro, Pa.
Steelton, Pa.
Standish, N. Y.
Johnson City, Tenn.

PIPE—RIGID ELECTRICAL CONDUIT:
Pittsburgh, Pa.
Evanston, Ill.

PIPE—STANDARD, LINE PIPE AND OIL COUNTRY TUBULAR PRODUCTS:
Pittsburgh, Pa.
Gary, Ind.
Lorain, O.

PLATES:
Pittsburgh, Pa.
Chicago, Ill.
Gary, Ind.
Birmingham, Ala.
Coatesville, Pa.
Sparrows Point, Md.
Gulf Ports
Pacific Coast Ports

RAILROAD TIE PLATES:
Pittsburgh, Pa.
Buffalo, N. Y.
Chicago, Ill.
Birmingham, Ala.
St. Louis, Mo.
Kansas City, Mo.
Minnequa, Colo.
Weirton, W. Va.
Portsmouth, O.
Steelton, Pa.
Pacific Coast Ports

RAILROAD TRACK SPIKES:
Pittsburgh, Pa.
Buffalo, N. Y.
Cleveland, O.
Chicago, Ill.
Birmingham, Ala.
Youngstown, O.
Portsmouth, O.
Weirton, W. Va.
St. Louis, Mo.
Kansas City, Mo.
Minnequa, Colo.
Philadelphia, Pa.
Lebanon, Pa.
Columbia, Pa.
Richmond, Va.
Jersey City, N. J.
Pacific Coast Ports

SHEET BARS:
Pittsburgh, Pa.
Buffalo, N. Y.
Cleveland, O.
Chicago, Ill.
Youngstown, O.
Canton, O.
Sparrows Point, Md.

SHEETS:
Pittsburgh, Pa.
Gary, Ind.
Birmingham, Ala.
Pacific Coast Ports

SKELP:
Pittsburgh, Pa.
Buffalo, N. Y.
Chicago, Ill.
Youngstown, O.
Coatesville, Pa.
Sparrows Point, Md.

STEEL SHEET PILING:
Pittsburgh, Pa.
Buffalo, N. Y.
Chicago, Ill.
Gulf Ports
Pacific Coast Ports

STRIP STEEL—COLD-ROLLED:
Pittsburgh, Pa.
Cleveland, O.
Worcester, Mass.

STRIP STEEL—HOT-ROLLED:
Pittsburgh, Pa.
Chicago, Ill.

STRUCTURAL SHAPES:
Pittsburgh, Pa.
Buffalo, N. Y.
Chicago, Ill.
Birmingham, Ala. (standard shapes only)
Bethlehem, Pa.
Gulf Ports
Pacific Coast Ports

TIN PLATE, TIN MILL BLACK PLATE AND TERNE PLATE:

Pittsburgh, Pa.
Gary, Ind.
Pacific Coast Ports

TUBES—BOILER:

Pittsburgh, Pa.

TUBE ROUNDS:

Pittsburgh, Pa.
Buffalo, N. Y.
Cleveland, O.
Chicago, Ill.
Birmingham, Ala.

WHEELS—CAR, ROLLED STEEL:

Pittsburgh, Pa.
Chicago, Ill.

WIRE—DRAWN, except as hereinafter specified:

Pittsburgh, Pa.
Cleveland, O.
Chicago, Ill.
Birmingham, Ala.
Anderson, Ind.
Duluth, Minn.
Worcester, Mass.
Gulf Ports:
New Orleans, La.
Galveston, Tex.
Houston, Tex.
Pacific Coast Ports

WIRE NAILS AND STAPLES, BARBED WIRE AND WIRE FENCING:

Pittsburgh, Pa.
Cleveland, O.
Chicago, Ill.
Birmingham, Ala.
Anderson, Ind.
Duluth, Minn.
Gulf Ports
Pacific Coast Ports

WIRE RODS:

Pittsburgh, Pa.
Cleveland, O.
Chicago, Ill.
Birmingham, Ala.

WIRE—SPRING:

Pittsburgh, Pa.
Cleveland, O.
Chicago, Ill.
Worcester, Mass.
Pacific Coast Ports

WIRE—TELEPHONE:

Pittsburgh, Pa.
Cleveland, O.
Waukegan, Ill.
Muncie, Ind.
Trenton, N. J.
Worcester, Mass.
Sparrows Point, Md.

SCHEDULE G.

MAXIMUM RATES OF DISCOUNT FOR EARLY PAYMENT AND MAXIMUM PERIODS OF FREE CREDIT.

Maximum Rates of Discount for Early Payment:

In the case of products shipped from plants located east of the Mississippi River to Pacific Coast Ports and which shall be invoiced from such plants —½ of 1%, if the invoice of such products shall be paid within 25 days from the date of such invoice; in all other cases—½ of 1%, if the invoice of such products shall be paid within 10 days from the date of such invoice; provided, however, in the latter cases, that any member of the Code may allow such discount of ½ of 1% for payment within 10 days on the basis of settlements three times in each month, as follows:

(1) On invoices for products dated from the 1st to the 10th, inclusive, in any month, such discount may be allowed on payment of such invoices on or before the 20th of such month;

(2) On invoices for products dated from the 11th to the 20th, inclusive, in any month, such discount may be allowed on payment of such invoices on or before the 30th of such month; and

(3) On invoices for products dated from the 21st to the end of any month, such discount may be allowed on payment of such invoices on or before the 10th of the next following month.

Any discount allowed in accordance with the provisions of this Schedule G shall apply only to the invoiced value of the products specified therein and not to any part of the transportation charges on such products.

Maximum Periods of Free Credit:

In the case of products shipped from plants located east of the Mississippi River to Pacific Coast Ports and which shall be invoiced from such plants —45 days; in all other cases—30 days.

SCHEDULE H.

LIST OF UNFAIR PRACTICES.

For all purposes of the Code the following described acts shall constitute unfair practices:

A.—Making or promising to any purchaser or prospective purchaser of any product, or to any officer, employee, agent or representative of any such purchaser or prospective purchaser, any bribe, gratuity, gift or other payment or remuneration, directly or indirectly.

B.—Procuring, otherwise than with the consent of any member of the Code, any information concerning the business of such member which is properly regarded by it as a trade secret or confidential within its organization, other than information relating to a violation of any provision of the Code.

C.—Imitating or simulating any design, style, mark or brand used by any other member of the Code.

D.—Using or substituting any material superior in quality to that specified by the purchaser of any product or using or substituting any material or any method of manufacture not in accord with any ap-

plicable law, rule or regulation of any governmental authority.

E.—Cancelling in whole or in part, or permitting the cancellation in whole or in part of, any contract of sale of any product, except for a fair consideration, or paying or allowing to any purchaser in connection with the sale of any product any rebate, commission, credit, discount, adjustment or similar concession other than as is permitted by the Code and specified in the contract of sale.

F.—Disseminating, publishing or circulating any false or misleading information relative to any product or price for any product of any member of the Code, or the credit standing or ability of any member thereof to perform any work or manufacture or produce any product, or to the conditions of employment among the employees of any member thereof.

G.—Inducing or attempting to induce by any means any party to a contract with a member of the Code to violate such contract.

H.—Aiding or abetting any person, firm, association or corporation in any unfair practice.

I.—Making or giving to any purchaser of any product any guaranty or protection in any form against decline in the market price of such product.

J.—Stating in the invoice of any product as the date thereof a date later than the date of the shipment of such product, or including in any invoice any product shipped on a date earlier than the date of such invoice.

K.—Making any sale or contract of sale of any product under any description which does not fully describe such product in terms customarily used in the Industry.

L.—Rendering to any purchaser of any product in or in connection with the sale of such product any service, unless fair compensation for such service shall be paid by such purchaser.

M.—Any violation of any other provision of the Code, whether or not therein expressed to be such, or using or employing any practice not hereinabove in this Schedule H described which the Board of Directors by the affirmative vote of three-fourths of the whole Board shall have declared to be a practice that would tend to defeat the policy of Title I of the National Industrial Recovery Act and, therefore, an unfair practice, and of which determination by such Board the Secretary shall have given notice to the members of the Code and to the President.

When Electric Lights Came To Youngstown*

By PETER ARLEN

Man Who Installed First Light Plant Looks Back

'Way back in those dim days of 1880, facetiously referred to as the "good old days," Youngstown got her first electric lights.

O. R. JONES

And, believe it or don't, that in those days was "page one stuff" which the boys on the local papers wrote with their tongues in their cheeks and the readers "ate up."

Curiosity seekers for miles around—from points as far as 50 miles distant—hurried to Youngstown to see the phenomenon and disbelieve. And 50 miles in 1880 was 50 miles.

Create Sensation

The man who installed one of the first electric lighting plants in Youngstown was O. R. Jones of 914 Belmont avenue, now an electrical engineer for the Sharon Steel Hoop Company.

Mr. Jones also was in charge of installing lighting plants in many of the Mahoning Valley mills and factories and stores and in building municipal lighting plants.

"And did those electric light plants create a sensation here," said Mr. Jones. "Remember, this was before Thomas Edison invented the incandescent lamp.

"Youngstown got the first four commercial electric light machines built. Two of them were installed in the Brown-Bonnell plant.

"Two others were installed in the G. M. McKelvey Company building and the lights were placed on a tower atop the building. The lamps were 2,000 candle-power each and the four lights on top the McKelvey tower did a good job of lighting up the entire downtown section of Youngstown."

*Reprinted from The Youngstown Vindicator, Youngstown, O.

Youngstown wasn't such a large place in those days—just an overgrown tank town of 15,000 or 16,000 persons, with a muddy morass known as Federal Street through its middle.

Wearily old street cars drawn by equally weary horses moved placidly down the main drag when they moved at all. The town was closed up at 9 p. m. and the lights furnished a lot of "white way" downtown lighting without cost to the town—and at the same time furnished the store with a lot of excellent advertising.

"Those lights attracted crowds from the entire Eastern Ohio and Western Pennsylvania district—attracted curiosity seekers who wouldn't believe a good powerful light could come from a string of copper wire.

Hard to Convince

"Seeing is believing—but that didn't convince the skeptics. Folks came in from Niles, Warren, Sharon, New Castle and other places just to stand and gaze at the lights. And remember, 25 or 30 or 40 or 50 miles was distance in those days unless you could ride the railroads.

"There weren't any automobiles or electric railway lines. There were few good roads. If you traveled at all, you rode the railroads, drove in a wagon or buggy or walked. And that's how they got here.

"The steel mills in those days were lighted up with big coal oil torches—which weren't so handy considering the fact that mill buildings in those days all were built of wood.

"Those new arc electric lights made night work much saver and easier in the mills which with the arc lights were as well illuminated as the mills are today."

A lot of amusing instances occurred after those lights were put in. The wires were all uncovered copper lengths put up with staples driven into the wood. No wiring inspector would pass any installations of that kind today.

"There was a lot of juice in those wires. Occasionally one of the boys would accidentally brush a piece of metal against the wires.

Then the sparks would fly, he would get a good shock and there would be loud cursing for a while. The mills were equipped with conveyor systems then called 'telegraphs.' Occasionally a wire would break and fall on the telegraph. Then anyone working nearby would get shocked.

"If there was a break in the wires—and the breaks were frequent—it put out all the lights and it meant tracing down the whole system.

No Lights in Homes

"There weren't any big electric plants and every little concern put up its own electric lighting plant. Of course there weren't any electric lights in the homes. Homes were lighted with candles, oil lamps or gas lights."

Mr. Jones helped install plants in the Brier Hill steel plants, Ohio Iron, Ohio Powder Company, Andrews Brothers Mill and the Hazelton Car Works, and many other plants. He also installed the first plants at Niles, Warren and Girard and was in charge of the municipal plant at Meadville, Pa., for five years.

An amusing incident occurred in installing one plant of which Mr. Jones was to have charge. Two young electrical "experts" were sent in from Cleveland to put up the equipment.

Frequently the "experts" prepared to do certain parts of the work in a certain way which was not the way Mr. Jones wanted it. In the end, Mr. Jones had directed practically all the work.

Then the "experts" began installing other plants and frequently sought out Mr. Jones' advice. Years later when Mr. Jones was in charge of the Meadville municipal light plant, he went to Buffalo to buy equipment and met one of the "experts" who greeted him cordially.

"Say," confided the man, "it was a good thing for us that we found you at Youngstown. My partner and I didn't know a thing about electric power plants."

All that came as no surprise to Mr. Jones.

Arc Lamps First

The first electric power and light company here was the Mahoning Electric Light Compay, which specialized in arc lighting. The Youngstown Electric Company later began installation of incandescent lights. The Mahoning and the Youngstown company engaged in a bitter business battle while Mr. Jones was employed by the Mahoning company.

"By that time, all the leading merchants were demanding electric lights for their stores. The arc lamps had been perfected so that they were suitable for store installations—but of course for convenience they didn't compare to present day lighting.

"Mr. Edison had just perfected the incandescent lamps. These lights weren't very powerful and they gave a lot of trouble and were quite as expensive as the arcs.

"A bitter war developed between the two companies. One week we were installing lights in a store. The next week the other company would be putting in wires and we would be ordered to tear out our installations."

The two companies later were consolidated and the war was ended. Mr. Jones has been with the Sharon Steel Hoop Company for many years. He is a charter member of the Association of Iron and Steel Electrical Engineers. He served as President of the organization in 1915.

ITEMS OF INTEREST

PERSONNEL CHANGES

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William G. Mather, one of the most prominent leaders in the iron and steel, iron ore, pig iron and Lake vessel industries, announced his desire to retire from the presidency of the Cleveland-Cliffs Iron Co., Cleveland, at a meeting of the directors August 24, in order to devote some of his time to travel and leisure. He has served the company and its predecessor 55 years, 42 years of which was as head of the Cleveland-Cliffs company. Edward B. Greene, prominent Cleveland banker, who has been a director and member of the executive committee for several years, was elected to succeed Mr. Mather as president. The change became effective September 1. Mr. Mather retains his affiliation with the company and activity in its affairs as chairman of the board, a position just created by the directors. Mr. Greene is chairman of the executive committee and a director of the Cleveland Trust Co., and will retain his official connection with the bank.

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Severn P. Ker, chairman of the board, Sharon Steel Hoop Co., Sharon, Pa., and a veteran executive in the steel industry, will resign his chairmanship of the Sharon company October 1. He will retain a directorship in the company. Mr. Ker entered the steel business in 1885 when he became associated with the La Belle Steel Co., Pittsburgh. Later he was with the American Steel Hoop Co., the Crucible Steel Co. of America, and Republic Iron & Steel Co. Until his resignation in favor of Henry Roemer as president of Sharon Steel Hoop Co. a few years ago, Mr. Ker had held the presidency for 21 years.

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B. E. Kibbee, vice president in charge of sales, Sharon Steel Hoop Co., Sharon, Pa., has been appointed executive vice president of the company, and Arthur Booth, general sales manager, has been appointed to the post left vacant by Mr. Kibbee's advancement. Thomas Galbreath, assistant sales manager, has succeeded Mr. Booth. Milton Hughes, general manager in charge of operations, has been appointed vice president in charge of operations. These changes follow upon the decision of Severn P. Ker to retire from the chairmanship of the company.

▲

H. E. Ewart has been appointed Pittsburgh district representative of the Bantam Ball Bearing Co., South Bend, Ind. He was formerly assistant chief engineer of the United Engineering & Foundry Co., Pittsburgh, prior to which time he was connected with the Tennessee Coal, Iron & Railroad Co., Birmingham. In his new capacity Mr. Ewart will be located in Pittsburgh and will represent his company on steel mill and industrial bearing applications.

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John E. Minty has been appointed general manager, Shaw-Box Crane & Hoist Co., Muskegon, Mich. He formerly was works manager, and has been associated with the company 12 years since his graduation from Cornell University.

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The Smoot Engineering Corporation, manufacturers of Smoot Control, have moved their general offices and factory to Summit, New Jersey, where they have set up complete engineering and manufacturing facilities for their apparatus.

Their former address at 136 Liberty Street, New York City, is still maintained as a sales office with Mr. H. R. Kessler in charge. A Pittsburgh office under the direction of Colonel C. L. Joly has been opened at 405 Bessemer Building, and a Chicago sales office will be opened in September.

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BOOK REVIEW

FOLLANSBEE FORGE ELECTRIC SHEETS

The Association of Iron and Steel Electrical Engineers are pleased to have the opportunity of reviewing the revised hand book of the Follansbee Forge Electric Sheets prepared by J. S. Murray, Chief Electrical Engineer of the Follansbee Brothers Company, and assisted by the research department of this company.

The purpose of this hand book is to furnish the consumer, designing engineer and student with magnetic and electrical data on silicon sheet steel used in the construction of transformers, rotating equipment and radios.

J. S. MURRAY

The data and information furnished was secured by extensive laboratory tests and results secured in the field of operation. The tests conducted conform to the American Society of Testing Materials standards and specifications.

In the compilation of the data and information,

(Please turn to page 260)

You Can Stop Worrying

ABOUT NEEDLESS ELECTRICAL SHUTDOWNS IF YOU USE THIS MODERN FUSE

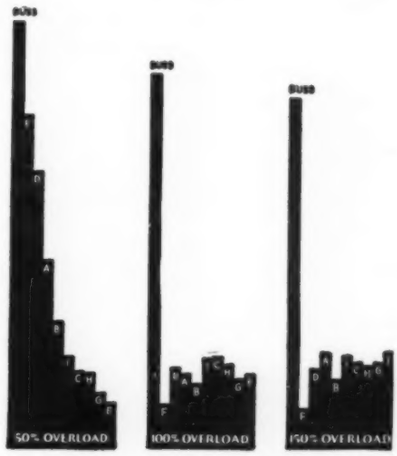
WHAT'S the use of getting grey hairs over those needless and costly shutdowns caused by fuses blowing on temporary or harmless overloads? Why continue to have machines stop and men stand idle because fuses blow needlessly? Why not take advantage of the new BUSS SUPER-LAG Fuse—a fuse designed to keep the plant operating as well as protecting the equipment—a fuse with a time-lag far in excess of any other?

Compare Blowing Time for Yourself

Just glance at the chart to the right. Note how the time required to blow the BUSS SUPER-LAG Fuse has been extended to a point never before thought possible. Can't you imagine what this *super time-lag* will mean to you in preventing fuses blowing on those harmless overloads that occur, at times, on all electrical circuits.

Surely you will want the full story so you can dig into the facts and find out for yourself that it will pay you to standardize on this latest invention in electrical protection.

We will be glad to send complete data by mail or have a representative call, whichever you prefer.



Blowing Time of BUSS SUPER-LAG Fuse Compared to Other Makes

These charts show results obtained in tests made by Electrical Testing Laboratories of New York as reported by them August 25th, 1930 on the 200 ampere 250 volt size. 30, 60, 100, 400 and 600 ampere sizes as reported by them show similar results.

Blowing times shown on one overload are not comparable with those at other overloads because a different scale is used on each chart for convenience in comparing results.

BUSS SUPER-LAG FUSES

BUSSMANN MANUFACTURING COMPANY, ST. LOUIS, MO.
A Division of the McGraw Electric Company

TUESDAY, OCTOBER 17th, 1933

9:00 A. M.—Registration: Chairman, C. A. Thayer, Chief Engr., Republic Steel Corp., Youngstown, Ohio.

9:15 A. M.—Business Session, Urban Room, 17th Floor, Chairman, W. E. Miller, President, A. I. & S. E. E., and Electrical and Mechanical Superintendent, Bethlehem Steel Co., Johnstown, Pa. Secretary, A. D. Adams, Asst. Supt., Spang Chalfant & Co., Inc., Ambridge, Pa.

MECHANICAL, ELECTRICAL AND LUBRICATION DIVISIONS

Technical Sessions, Urban Room, 17th Floor, Chairman, W. E. Miller, Elec. and Mech. Supt., Bethlehem Steel Co., Johnstown, Pa. Secretary, A. D. Adams, Asst. Supt., Spang Chalfant & Co., Inc., Ambridge, Pa.

9:30 A. M.—"Developments in the Iron and Steel Industry" by W. H. Burr, Elec. and Mech. Supt., Lukens Steel Co., Coatesville, Pa.

Chairman, C. A. Kral, Supt. of Blooming Mill, Bar and Hot Strip Mills, Wheeling Steel Corp., Steubenville, Ohio. Secretary, J. W. Bates, Elec. Engr., Power Div., American Sheet & Tin Plate Co., Pittsburgh, Pa.

10:15 A. M.—"A Review of Cold Mill Practices—Sheet, Tin and Strip,' by Stephen Badlam, Consulting Engineer, Pittsburgh, Pa.

Chairman, G. R. Carroll, Elec. Supt., Jones & Laughlin Steel Corp., Aliquippa, Pa. Secretary, H. G. Gibson, Chief Engr., McKeesport Tin Plate Co., McKeesport, Pa.

1:30 P. M.—"Electrical Features of Modern Cold Roll Strip Mills," by A. F. Kenyon, General Engr., Westinghouse Elec. & Mfg. Company, East Pittsburgh, Pa.

2:30 P. M.—"Recent Developments in Cold Strip Mill Electrical Equipment," by F. Mohler, Industrial Engineering Department, General Electric Co., Schenectady, N. Y.

3:30 P. M.—"Controlling Screwdown Drafts to the Exact Specification of the Mill Superintendent," by D. C. Wright, Chief Engr., Electric Controller & Mfg. Co., Cleveland, Ohio.

WEDNESDAY, OCTOBER 18th, 1933

MECHANICAL, ELECTRICAL AND LUBRICATION DIVISIONS

Technical Sessions, Urban Room, 17th Floor, Chairman, B. R. Shover, Consulting Engineer, Pittsburgh, Pa. Secretary, R. E. Lewis, Elec. Supt., Youngstown Sheet & Tube Co., Youngstown, Ohio.

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OCTOBER

WILLIAM PENN HOTL

9:30 A. M.—"Anti-Friction Bearings in Connection with Cold Mills," by F. C. Hallmark, Gen. Master Mech., Wheeling Steel Corp., Steubenville, Ohio. C. J. Klein, Chief Engr., Weirton Steel Co., Weirton, W. Va.

Chairman, C. C. Pecu, Lubrication Engr., Bethlehem Steel Co., Lackawanna, N. Y. Secretary, S. H. McKee, Consulting Engineer, Youngstown, Ohio.

10:00 A. M.—"Mechanical, Lubrication and Electrical Problems in Connection with Reduction Gear Sets of Main Drive Mill Motors," by T. Holloway, Gear Consultant, United Engineering & Foundry Co., Pittsburgh, Pa. Austin Kuhns, Engineer, Farrel-Birmingham Co., Inc., Buffalo, N. Y.

12:30 P. M.—Inspection Trip—by Special Chartered Buses Only.
Allegheny Steel Co., at Brackenridge, Pa.
American Sheet & Tin Plate Co. at Vandergrift, Pa.
Transportation Tickets for this trip on sale at Registration Booth, Main Lobby, William Penn Hotel.

MEMBERS, GUESTS AND EXHIBITORS INVITED

THURSDAY, OCTOBER 19th, 1933

WELDING ENGINEERING DIVISION

Technical Sessions, Urban Room, 17th Floor. Chairman, G. A. Hughes, Elec. Engr., Truscon Steel Company, Youngstown, Ohio. Secretary, J. A. Morgan, Asst. Supt., Maintenance Dept., Carnegie Steel Co., Braddock, Pa.

9:30 A. M.—"Welding Practices in the Iron and Steel Industry in Connection with Arc Welding Equipment, Automatic Arc Welding, Electrodes, Operators, Carbon Arc Welders, Resistance Welding, Atomic Hydrogen Welding, Acetylene Welding and Thermit Welding" (Information and Data furnished through a Questionnaire by the Iron and Steel Industry.)

'OGRAM

D STEEL EXPOSITION

EEL ELECTRICAL ENGINEERS

19, 1933

PITTSBURGH, PA.

10:00 A. M.—"Growth of the Electric Arc Welding Industry," by E. A. Hurme, Engineer, Clark Controller Co., Cleveland, Ohio.

10:30 A.M.—The Part Welding is Playing in the Building of Metal Homes," by Bennett Chapple, Vice Pres., American Rolling Mill Co., Middletown, Ohio.

11:00 A. M.—"Welded Rolled Steel Products," by F. L. Lindemuth, Chief Engr., Wm. B. Pollock Co., Youngstown, Ohio.

1:30 P. M.—"Advantages of Welded Design with Reference to Weight, Strength, Time and Costs," by A. E. Gibson, Vice Pres., Wellman Engineering Co., Cleveland, Ohio.

2:00 P. M.—"Advantages to Be Secured Through Welding in Mill Building," by Lloyd Jones, General Manager, E. W. Bliss Co., Salem, Ohio.

2:30 P. M.—"Rolled Steel Products and Arc Welding in the Fabrication of Electric Locomotives," by R. V. Devlin, Industrial Locomotive Division, General Electric Co., Erie, Pa.

3:00 P.M.—"Utilization of Electric Welding in Structural Steel Building," by Gilbert D. Fish, Consulting Structural Engineer, Westinghouse Elec. & Mfg. Company, East Pittsburgh, Pa.

THURSDAY, OCTOBER 19th, 1933

COMBUSTION ENGINEERING DIVISION

Technical Sessions, Cardinal Room, 17th Floor. Chairman, F. E. Leahy, Fuel Engr., Youngstown Sheet & Tube Co., Youngstown, Ohio. Secretary, J. L. Miller, Steam Engr., Carnegie Steel Co., Youngstown, Ohio.

9:30 A. M.—"Fundamentals of Open Hearth Design," by W. C. Buell, Jr., Engineer, Cleveland, Ohio.

10:00 A. M.—"Recent Improvements in Design and Operation of Industrial Furnaces," by G. A. Merkt, Engr., Combustion Control Department, Morgan Construction Co., Worcester, Mass.

10:30 A. M.—"Heating Slabs for Hot Strip Mills," by W. R. Culbertson, Mgr., Furnace Div., Rust Engineering Co., Pittsburgh, Pa.

1:30 P. M.—"The Utilization of Wide Sheet Bar Through Recent Developments in Pair and Pack Heating Furnaces," by R. J. Wean, Pres., Wean Engineering Co., Warren, Ohio.

2:00 P. M.—"Electric Furnaces for Annealing Strip and Sheets," by A. N. Otis, Industrial Engineering Department, General Electric Co., Schenectady, N. Y.

9:00 P. M.—Formal Reception.

10:00 P. M.—Award of Prizes "New Uses for Steel Contest."

IRON AND STEEL EXPOSITION

As in previous years, the Iron and Steel Exposition will be one of the features of the Annual Convention. The object of the Iron and Steel Exposition is to acquaint engineers with the status of the art in reference to the various lines of apparatus used in the Industry. Accomplishments by the use of improved devices, new applications, etc., will largely form the subjects of the papers and discussions at the technical sessions. Technical papers and discussions regarding the improvement of the quality of product and economy of operation develop the urge to make improvements. Exhibits and Expositions develop this urge into a real desire as concrete suggestions and ideas are presented in these equipment displays.

In the Iron and Steel Exposition each year, the manufacturers who service the Iron and Steel Industry are presented an opportunity to display or exhibit the new developments in their products and equipment to the engineers and executives of the Iron and Steel and allied Industries. It is at the Exposition that the engineers and executives have the opportunity to inspect, examine and have demonstrated to them just what the equipment will do for them in their plants.

EXPOSITION HOURS

(Opens) Tuesday, 1:30 to 5:30 P. M. Evening, 7:00 to 10:00 P. M.

Wednesday, 9:00 A. M. to 5:30 P. M. Evening, 7:00 to 10:00 P. M.

Thursday, 10:00 A. M. to 10:00 P. M. (Closes.)

(Continued from page 256)

the author kept in mind the practical as well as the engineering problems confronting the electrical designers and fabricators in the application of silicon steel with the result that this new hand book is a valuable addition to the electrical art.

The Association is more than pleased to extend to Mr. Murray, one of our active and progressive members, their congratulations on his successful preparation of a hand book which will be a useful tool in the electrical industry.

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LIST OF EXHIBITORS

IRON AND STEEL EXPOSITION

OCT. 17—19, 1933 PITTSBURGH, PA.

ALLIANCE MACHINE CO.	16
ALLIS-CHALMERS MFG. CO.	33
BACHARACH INDUSTRIAL INSTRUMENT CO.	40
BAILEY METER CO.	22
BARTLETT-HAYWARD CO.	31
BENJAMIN ELECTRIC MFG. CO.	23
BULLDOG ELECTRIC PRODUCTS CO.	14
BURNDY ENGINEERING CO.	46
CLARK CONTROLLER CO.	3
COLTS PATENT FIRE ARMS MFG. CO.	21
CROUSE-HINDS CO.	34
CUTLER-HAMMER, INC.	18-19
DUQUESNE LIGHT CO.	24
EDISON STORAGE BATTERY CO.	47
ELECTRIC CONTROLLER & MFG. CO.	35-36
FAFNIR BEARING CO.	28
FARVAL CORPORATION	26
FOXBORO COMPANY	17
GENERAL ELECTRIC CO.	49-50
GENERAL ELECTRIC SUPPLY CORP.	51-52
GORDON & CO., R. M.	1
GRAYBAR ELECTRIC CO., INC.	14
G & W ELECTRIC SPECIALTY CO.	46
GREAT WESTERN FUSE CO.	30
HABIRSHAW CABLE & WIRE CORP.	14
HOMESTEAD VALVE & MFG. CO.	4
HYATT ROLLER BEARING CO.	12
I-T-E CIRCUIT BREAKER CO.	43
KEYSTONE LUBRICATING CO.	44
LAPP INSULATOR CO., INC.	46
LEEDS & NORTHRUP CO.	37-38
MORGAN ENGINEERING CO.	5
MULLER & CO., HENRY N.	46
NATIONAL ARMATURE & ELECTRICAL WKS.	41
NATIONAL CARBON CO.	20
OHIO CARBON CO.	29
OTIS ELEVATOR CO.	48
PENNSYLVANIA LUBRICATING CO.	42
PITTSBURGH REFLECTOR CO.	14
POOLE FOUNDRY & MACHINE CO.	15
RELIANCE ELECTRIC & ENGR. CO.	7
ROLLER-SMITH CO.	46
ROLLWAY BEARING CO., INC.	2
SCHWEITZER & CONRAD, INC.	46
S-K-F INDUSTRIES, INC.	9-10
TIMKEN ROLLER BEARING CO.	25
TOOL STEEL GEAR & PINION CO.	27
TRUMBULL ELECTRIC MFG. CO.	6
UNITED AMERICAN BOSCH CORP.	32
UPTEGRAFF MFG. CO., R. E.	45
WESTINGHOUSE ELECTRIC & MFG. CO.	11-39
WESTINGHOUSE LAMP CO.	11-39
YALE AND TOWNE MFG. CO.	8

ASSOCIATION NOTES

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The Annual Fall Golf Tournament of the Chicago district will be held at the Woodmar Country Club, 1818 - 177th Street, Hammond, Indiana, on Tuesday, September 19. Due to the convenient location of the Golf Club, it is hoped that all members will be present. Guests are cordially invited.

Executive Committee: K. E. Dinius, Chairman; C. J. Smith, Vice Chairman; A. J. Whitcomb, Secretary; W. A. Perry, W. J. Tunney, J. F. Headlee and H. G. Hague.

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NATIONAL SAFETY COUNCIL—METAL SECTION PROGRAM

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General Chairman, ROBERT L. SCHMITT, Louisville Car Wheel and Railway Supply Co., Louisville, Ky.
Vice-Chairman, E. F. BLANK, Jones & Laughlin Steel Corp., Pittsburgh.
Vice-Chairman, J. A. VOSS, Republic Steel Corp., Youngstown, O.
Secretary and News Letter Editor, H. W. DARR, Bethlehem Steel Co., Johnstown, Pa.

MONDAY AFTERNOON

October 2
Exhibition Floor, Centennial Hall

2:00 Resume of Year's Activities.
General Chairman, Robert L. Schmitt.
2:15 The New Deal in Safety.
J. Russell Craig, Safety Dir., Pennsylvania Indemnity Corp., Philadelphia.
3:00 Discussion.
3:15 Correlating Safety with Plant Operations in a Steel Mill.
F. M. Gillies, Asst. Gen. Supt., Indiana Harbor Mill, Inland Steel Co., Indiana Harbor, Ind.
4:00 Discussion.
4:15 Using Our Statistics to Advantage. (Illustrated.)
W. D. Speight, Safety Dir., Keystone Steel & Wire Co., Peoria, Ill.

WEDNESDAY MORNING

October 4
Exhibition Floor, Centennial Hall

9:45 Safety in the Car-Building Industry.
(Speaker to be announced.)
10:15 Discussion.
10:25 The Safe Operation and Maintenance of Unfired Pressure Vessels.
E. R. Fish, Chief Eng., Boiler Division, The Hartford Steam Boiler Insurance Co., Hartford, Conn.
10:50 Discussion.
11:00 Election of Officers.
11:10 Health Hazards in Foundries and Their Elimination.
Dr. Carey P. McCord, Medical Dir., The Industrial Health Conservancy Laboratories, Cincinnati.
11:50 Discussion.

THURSDAY MORNING

October 5
Exhibition Floor, Centennial Hall

9:45 Data on the 1932-33 Safety Contest.
General Chairman, Robert L. Schmitt.
10:00 Presentation of Awards.
An officer of the National Safety Council.
10:15 Safety Kinks—Handling Materials by Hand.
(Illustrated.)
John A. Oartel, Chief of Safety Bureau, Carnegie Steel Co., Pittsburgh.
11:15 Your Hour.
Led by T. H. McKenney, Supervisor of Labor and Safety, Illinois Steel Co., South Chicago, Ill.

Copies of complete program may be had by addressing W. H. Cameron, Mgr. Dir. National Safety Council, Inc., 20 N. Wacker Drive, Chicago, Ill.